CREDA

Yukon 20

Senior Citizens Retrofits

CREDA is a program which has been jointly funded by Energy, Mines and Resources, Canada and the Yukon Government, Department of Economic Development and Tourism. For more information or copies of reports contact the Energy and Mines Branch, Yukon Government, Box 2703, Whitehorse, Y1A 2C6.

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FOREWORD

The availability of secure and affordable energy supplies is a subject of national concern. Our primary energy sources are becoming more costly and less accessible. However, Canada has both the resources and technical expertise needed to develop renewable and alternative sources of energy.

The governments of Yukon and Canada have entered into a Conservation and Renewable Energy Demonstration Agreement as one means of pursuing this end. Cost shared by the territorial and federal governments, CREDA has a budget of $3.3 million and is dedicated to the development and demonstration of conservation and renewable energy technologies.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

The Seniors' Residential Retrofit Program which is reported in the following pages underlines the importance and benefits of retrofitting techniques for energy conservation. The program facilitated in the actual retrofitting of several homes and, through a training program, ensured that a qualified and knowledgeable group of people was available for the retrofitting industry it hoped to establish.

EXECUTIVE SUMMARY

The Seniors' Residential Retrofitting Project was Yukon's most ambitious CREDA - funded demonstration with a total cost of $460,000. The project undertook to demonstrate energy-efficient retrofitting techniques in 38 homes and two apartment complexes for senior citizens. At the same time, the project strove to train Yukon tradesmen in retrofitting techniques, thus creating a local industry and employment within this industry. To this end, two training courses were given for local tradesmen and contractors, the first of its kind in Canada. The training part of the project was given equal importance as the actual demonstration part.

The target group for this project was the territory's senior citizens. They were chosen for their need for lower heating bills and their high profile in communities. The actual recipients of the retrofit work were those who responded to the initial contact made by CREDA officials and who were convinced of the benefits of the energy saving measures.

Three levels of retrofit work were done on the homes of senior citizens. Group one included caulking, weatherstripping, furnace servicing, and installation of water flow restrictors, water heater blankets and timers. The Group two retrofit included the treatment in level one, plus upgrading windows and the insulation levels in walls and ceilings. A Group three retrofit involved a total rewrap of the building shell with some of the features in groups one and two incorporated.

The demonstration program was run on the following basis: (1) initial contact with senior citizens; (2) energy audit on each house; (3) determination of level of retrofit work based on individual audit results; (4) contract packages drawn up and put to tender; (5) monitoring of fuel records and air-tightness tests both before and after retrofit; (6) tabulation of data and information transfer.

The two training programs consisted of a 20 day and a three day course in retrofit construction techniques with theory and practical experience, both for tradesmen and contractors.

There were problems associated with the project resulting from the scope of the project and the particular demonstration clients. Other problem areas include project administration, retrofit specifications and tendering procedures, training programs, and some actual retrofit work.

However, the project on the whole was a success with the houses and the two apartments having received various energy efficient measures and the inception of a training course for local tradesmen and contractors. The seniors were for the most part pleased with the calibre of the retrofit work and the resulting energy savings.

Rapport pour l'exécutif

D'un coût total de $460 000, le projet de rénovation et de ré-isolation de résidences de personnes âgées s'est avéré la plus ambitieuse démonstration effectuée au Yukon à laquelle ait souscrit la CREDA. Le projet a entrepris de démontrer les techniques de rénovation et de ré-isolation à haut rendement énergétique dans 40 résidences de personnes âgées, soit 38 maisons et 2 immeubles à logements multiples. En même temps, les promoteurs du projet désiraient enseigner aux gens de métier de la construction du Yukon les techniques de rénovation et de ré-isolation, créant ainsi une industrie locale et fournissant du travail à l'intérieur de celle-ci. A cette fin, deux cours de formation ont été donnés aux gens de métier de la construction locaux et aux contracteurs, les premiers du genre au Canada. On a donné à la partie formation du projet une importance égale à celle de la démonstration.

Le groupe visé par ce projet était les personnes âgées résidant dans le territoire. On avait choisi ces personnes en raison de leurs besoins d'abaisser leurs factures de chauffage et de la place importante qu'elles occupent dans les communautés. Concrètement, les bénéficiaires de ces travaux de rénovation et de ré-isolation ont été ceux qui avait répondu au contact initial des fonctionnaires de la CREDA et qui étaient convaincus des bénéfices offerts par l'application de mesures à haut rendement énergétique.

Trois niveaux de travaux de rénovation et de ré-isolation ont été effectués sur les maisons de personnes âgées. Les travaux effectués au premier niveau comprenaient le calefeutrage, la pose de ruban coupe-froid, le nettoyage et la mise en ordre de la chaudière et l'installation d'économiseur d'eau, de manteaux isolants pour les chauffe-eau et de minuteries. Au deuxième niveau, les travaux effectués comprenaient ceux de premier niveau plus l'ajustement des fenêtres et la pose de matériaux isolants supplémentaires dans les murs et le toit. Au troisième niveau, les travaux consistaient en une ré-isolation extérieure complète de la maison en incorporant quelques unes des caractéristiques des niveaux un et deux.

Le programme de démonstration s'est déroulé de la façon suivante: (1) contact initial avec les personnes âgées; (2) vérification des besoins et de la consommation d'énergie de chaque maison; (3) détermination du niveau des travaux de rénovation et de ré-isolation à être effectués en fonction des résultats de la vérification individuelle; (4) rédaction des contrats couvrant tous les aspects des travaux et la mise de ces contrats en adjudication; (5) contrôle des données obtenues pour la consommation de combustible et des résultats des tests d'étancheité, avant et après les travaux de rénovation et de ré-isolation; (6) tabulation des données et diffusion des renseignements amassés.

Les deux programmes de formation ont consisté en un cours d'une durée de 20 jours et un autre de 3 jours durant lesquels les contracteurs et les gens de métier de la construction ont appris, en théorie et par l'expérience pratique, les méthodes de construction de rénovation et de ré-isolation.

Certains des problèmes relatifs au projet ont été occasionnés par l'ampleur de ce dernier et par la nature particulière des clients recrutés pour la démonstration. Les autres problèmes avaient trait à l'administration-même du projet, aux spécifications contenues dans les contrats et à la procédure de mise en adjudication, aux programmes de formation et à quelques travaux de rénovation et de ré-isolation effectués.

Néanmoins, le projet dans l'ensemble s'est avéré un succès alors que les maisons et les deux édifices à logements multiples ont été dotés de diverses mesures à haut rendement énergétique et que les contracteurs et les gens de métier de la construction locaux ont eu l'occasion de suivre un cours de formation. Dans la plupart des cas, les personnes âgées se sont dites satisfaites de la qualité des travaux effectués et se sont réjouies des économies d'énergie entraînées.

INTRODUCTION

The Residential Retrofit Project for Yukon senior citizens was proposed in the fall of 1982. Until then there had been little work of any significance done in the area of residential retrofits. As the existing housing stock is expected to represent the majority of residential energy requirements well into the next century, it is crucial that measures be undertaken to improve the energy efficiency of this housing stock. Yukon is dependent on an imported supply of expensive fuel oil to meet 50% of residential space and water heating needs.[1] Conservation is now being regarded as an energy supply option.

The objectives of the project were to determine the cost effectivenesses of a range of energy conservation measures in the residential sector under Yukon conditions, and to train local tradespeople in energy efficient construction techniques and make them aware of the importance of such techniques. The residential retrofit demonstration was intended to supply sufficient information to both homeowners and builders on the costs and benefits of various retrofit measures under differing Yukon conditions. The project under the Canada/Yukon Conservation and Renewable Energy Agreement was entered into for the amount of $460,000, designed to cover the majority of the costs of the project with the homeowners contributing up to 30 per cent of the retrofit costs.

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1. M.S. Shaffer, Yukon Energy Inventory and Utilization Review, 1983.

The project was characterized by a number of phases providing both demonstration and instruction. The demonstration phase included various levels of retrofit work on 38 houses throughout the Yukon and on two senior citizens' apartment complexes in Whitehorse. The demonstration work on private houses began with the selection of the target audience, followed by a residential energy audit, the compilation of this data, and the classification of the required retrofit measures into three categories, the tendering of the work and the retrofit work itself. Monitoring of fuel or electricity consumption was to be done both before and after the work. The instructional part consisted of a 20 day and a three-day retrofit techniques training course for both tradesmen and contractors.

There were three categories of work to be done on private houses, and a fourth category comprising two apartment buildings for senior citizens. Group one homes were to be given the following treatment - caulking and weatherstripping of all accessible air leaks; oil furnace servicing; installation of water flow restrictors and water heater blankets, and other minor modifications such as timers.

Group two homes were to be given all the treatment for Group one homes, plus the following: attic insulation upgrading, windows upgraded to triple-paned, installation of night set-back thermostats, and other modifications recommended in the analysis.

Group three homes were to be used to demonstrate the effectiveness of a total rewrapping of the building shell. Many features from Groups one and two were also incorporated.

Group four consisted of the two apartment complexes for senior citizens, managed by Yukon Housing Corporation. The retrofit work on these two buildings was managed separately from the individual houses and will be discussed in a separate section.

The project was administered by the Department of Economic Development and was overseen by a steering committee made up of representatives from territorial and federal energy conservation agencies. Yukon Housing Corporation (YHC) became involved by providing management services, valued at $35,000, for the tendering process and supervising the retrofit work in return for retrofit work done on the two YHC-managed apartment complexes, valued at $107,000.

The Senior's project was significant in two ways. One, it was a large scale retrofitting demonstration, the first of its type in Yukon to determine the cost effectiveness of different energy conservation options. Two, it has created an opportunity for local tradesmen to be trained in retrofitting and energy conservation theory and techniques.

SELECTION OF TARGET GROUP

To facilitate the selection of homes to participate in the project, it was decided to limit the project to senior citizens. There were a number of reasons for this choice. First, in Yukon, heating with expensive imported fuel oil means the cost of heating a house is two to three times higher than it would be for the same house in southern Canada where cheaper alternatives are available and where the heating season is considerably shorter. Being on fixed incomes for the most part, senior citizens are the most affected consumers when oil prices rise. Second, almost without exception, senior citizens live in less than energy efficient houses where heating costs consume an increasingly larger amount of a fixed income. Third, senior citizens enjoy a high profile in the community, as many are long term Yukon residents and have contributed considerable time and energy in developing the Yukon into what it is today. It is acceptable on all accounts to offer the benefits of energy efficient measures to this group who are often physically and financially incapable of doing the work themselves. As they often had no alternatives but to pay their escalating heating costs, the Residential Retrofit program offered them an inexpensive solution to their dilemma.

Although the idea of having senior citizens benefit from the retrofit work was very commendable, it did create some unforeseen problems, some of which stem from the target group itself and some from the method of selection. Out of the 211 people originally contacted, 92 agreed to procede with the first stage, but there were more drop-outs as the project evolved. The lack of response to the project was disappointing and the apparent lack of enthusiasm proved to be a major stumbling block. Enthusiasm, or at least interest, is an essential element in any project, and without it problems become compounded. Some participants did show a greater degree of interest than others, but project administrators found that a major effort was needed to keep people involved. In retrospect, it can be suggested that for future projects of this nature and scope the participants would better be selected on the basis of their own interest as demonstrated by applying to be a candidate for retrofit work.

Homeowner attitudes played a increasingly significant role as the project became established. Senior citizens have a different lifestyle than younger people in that their homes play an even more central role in their lives. They spend more time there, and, because they have lived in their houses for many years, a deep sense of pride exists and a general unwillingness to change prevailed. Any proposed changes to the home involved a certain amount of anxiety. Some seniors were unwilling to have others do work they felt they could do themselves. If in the course of the retrofit work unexpected complications or delays arose, the seniors felt a great deal of consternation. The seniors were not an easy audience to convince of energy efficient measures and the concepts of energy use and conservation. There will always be some who open windows in the coldest of conditions.

In addition, some of those living in public housing felt the initiatives should have been directed towards more tangible improvements to their standard of living. The residents of the Alexander Street apartment, for example, were miffed that the government would spend so much to conserve energy, at no apparent direct benefit to themselves, when they would have preferred to have had private washrooms instead.

The project made allowances for various types of homes - log, frame, mobile and rental. There was indeed a wide variety, but the age and structural weaknesses created another round of problems. Working with walls, windows and doors out of plumb, and with construction styles often 50 to 70 years old was not easy. In the end, as many older homes contravened existing municipal bylaws, special permission had to obtained from the City of Whitehorse to do retrofit work. The City was generally very cooperative.

On account of these factors, it may be concluded that the target audience should have been a volunteer-type group. Some problems would have been eliminated as the government could also have had provisions for setting its own limits or conditions if necessary. There would have been less of a feeling of forcing the demonstration upon its audience, and more of a feeling of cooperation.

Despite the problems encountered with the target group, there were many positive aspects. Several individuals, impressed by the results in the homes of friends or relatives, have requested more information on participation in a similar type of project. The seniors were for the most part satisfied with the calibre of the retrofit work and the professionalism of the contractors.

HOMEOWNER COSTS AND REBATE PROGRAMS

As mentioned in the Introduction there were three levels of retrofit work. The homeowners were expected to pay a certain portion of the work depending on the level of retrofit. They were also eligible to claim a sizable portion of that under the then existing federal government grants for upgrading work. The financial package available for all levels of work was very attractive.

There were four government programs through which money was recoverable: the Canadian Home Insulation Program (CHIP), Canada Oil Substitution Program (COSP), Canadian Home Renovation Plan (CHRP), and the Residential Rehabilitation Assistance Program (RRAP). In order to qualify for these rebates, work had to have been done by a Canadian General Standards Board (CGSB) listed tradesman. The training courses, described later in the report, ensured this criteria was available.

The CHIP program paid 60% of the cost of insulation and vapour barrier materials and labour to a maximum of $500. COSP covered 50% of the cost of insulation, vapour barrier, window glazings or heating system conversions to a maximum of $800. These two programs were taxable grants. The CHRP loan was available for renovations to standard housing after the CHIP and COSP grants were utilized. The CHRP had a $3,000 maximum to cover 30% of labour and materials when contracted labour accounted for one third of the total project work. Unfortunately the CHRP program was due to expire on April 30, 1983 and subsequently created a problem as the tenders for major retrofits (which required CHRP) would not be drawn up and tendered until late spring. RRAP was for substandard housing, had a maximum of $8,250, and had to be applied to at least one of the following - wiring, plumbing, foundation work or insulation. For those with incomes of $13,000 or less it was a grant; for those with incomes between $13,000 and $21,000 a portion was repayable; and for those with incomes over $21,000 all was repayable.

The Deputy Minister of Economic Development made some special requests to CHMC in order that homeowners could take advantage of CHRP. Besides the April 30, 1983 deadline, potential problems were seen as it was difficult to combine RRAP and CHRP for the same home as RRAP is for substandard housing. The programs could be used sequentially, RRAP first, then CHRP, but the construction schedule would not permit any work to be started until after the CHRP deadline had expired.

The requests were, first, for an additional $50,000 to the original Yukon allocation of $25,000; this was granted. Secondly, that CMHC accept CHRP applications in advance of the work to be done under RRAP for those houses that needed structural and other deficiencies remedied in conjunction with the retrofit work. Thirdly, to allow a four week extension on the April 30 deadline for the CHRP applications submitted under CREDA. The work was to be tendered by April 30, but the contracts not awarded until the third week in May.

To accommodate the last two requests, special arrangements were worked out among YTG (Yukon Territorial Government) Energy/Special Programs Branch, YHC and CMHC. These involved YHC undertaking to be the contractor for the renovations, providing the homeowners with fixed prices for the work proposed.

YHC was able to subcontract the work, but still held all responsibility for completing the work to the owner's satisfaction for the contract price. To ensure that all the applications were received on time YTG coordinated the completion of forms, including the homeowner's signature.

In the end, all those who applied for CHRP got the grant and had a six-month limit from date of authorization in which to use it, with the possibility of a three month extension.

No one, in fact, used RRAP. In order to qualify the homeowner had to have a substandard house and a very small income. The advantages diminished as the homeowner's income level increased. These qualifications, plus the fact that RRAP and CHRP could not be used simultaneously, meant it was not feasible to use the program.

In Groups one and two, homeowners were required to contribute the lesser of one half the cost of retrofit or the expected first year's full savings. The expected savings was in all cases the lesser amount and ranged from $165 to $1,095. Cost of retrofit work ranged from $1,635 to $7,200. There were in fact, no houses in the Group one category if one follows the exact guidelines. Many houses had Group one work (caulking, weatherstripping) plus some degree of window upgrading or extra insulation, which places them in the Group two category. However, this did not affect the cost-sharing. The homeowner's share was paid directly to the contractor and the receipt could be used to recover money through the CHIP and COSP grants.

For the Group three retrofits, at a maximum of $17,000, the homeowner's share was as follows: 50% of the first $2,000, 40% of the next $2,000, 30% of the remainder. Thus the maximum contribution would be $5,700. COSP and CHIP together allowed a total of $1,300 to be claimed (which was taxable) and, while it existed, a further $3,000 (nontaxable) was available through CHRP. CREDA viewed the contributions of CHIP, COSP, and CHRP as homeowner contributions.

In turn CHRP viewed the CREDA contribution as a homeowner contribution. The net effect of this combination of programs meant most homeowners could do major retrofit work, valued at $17,000, for a net personal cost of $1,400, or $4,400 after CHRP expired.

Unfortunately the CHIP and COSP grants were at times a source of irritation to homeowners on account of the slow delivery of their rebates. It was necessary to send applications to out-of-territory offices. The rebates often took six weeks to arrive and caused some aggravation for those on a fixed income and a tight budget. However, the benefits of the rebate programs far outweighed the inconvenience, as in many cases the seniors would not have been able to afford the work without them.

TRAINING PROGRAM

PURPOSE

The objective of the training program was to train local tradespeople in energy efficient construction techniques, and to develop an awareness of their importance. The training program was meant to be an effective vehicle to deliver many of the principles of retrofitting and good construction practices to the local builders. Poorly executed retrofit measures, such as adding extra insulation to an attic but neglecting to seal the air leaks can not only be ineffective but can complicate any future retrofit work. Past experience in much smaller retrofit projects has shown that even experienced builders did not deliver a satisfactory product, particularly a continuous air-vapour barrier, probably due both to a lack of motivation and understanding of its importance, and a lack of awareness of the recently developed techniques for achieving this goal.

The course was designed to provide instruction in energy-efficient housing construction according to national building standards. The successful completion of the retrofitting course allowed tradesmen to write for Canadian General Standards Board (CGSB) certification. The possession of the CGSB certification allowed the tradesmen to place bids on the project tenders and also meant the homeowners were eligible for the various government grants, such as COSP, CHIP, and CHRP.

The training program was granted the same importance as the actual demonstration part of the project. To this end, a 20 day course was carefully planned to instruct Yukon tradesmen in retrofit construction, a first of its kind in Canada.

COURSE DEVELOPMENT AND DELIVERY

At the request of the Energy/Special ARDA Programs Branch, the Advanced Education and Manpower Branch, of the Department of Education, was involved in the planning of the retrofit training course. A Technical Advisory Committee was created to provide advice to Advanced Education and Manpower on technical aspects and to ensure appropriateness of the course content to Yukon conditions. The committee was made up of seven people from the various departments involved in or related to the retrofit program.

The selection of a consultant to develop and deliver the course was a most important objective. With guidelines developed by the committee, the successful consultant was to satisfy the following criteria: design a fully developed curriculum by the course's April 5th start; have wide experience in retrofit techniques, and address all aspects of the Seniors' retrofit project, such as thermo-dynamics, air-vapour barriers, solar energy, heating systems, computer modelling; and have a knowledge of the government programs for financial assistance. In addition to these requirements, it was desired that the consultant be experienced, have an understanding of Yukon's energy situation and the scope of the project, have clarity of methodology and presentation, plus deliver the course at minimum cost.

Invitations for proposals for the development and delivery of a course were sent to various institutions or individuals involved in retrofit training or work. Of the several proposals received, Renewable Energy in Canada, a group of retrofit experts, was found to best satisfy the aforementioned requirements. The cost of the course was $45,156. The Energy/Special Programs Branch contributed $35,156, while the Advanced Education and Manpower Branch contributed $10,000.

The course was meant to be a 20 day program for 20 students, and to be offered on an annual basis until the need for it no longer existed. It was meant for people already having a working knowledge of standard construction methods. It was offered through the vocational training centre, and combined a theoretical and practical approach with approximately two-thirds of the course's duration spent applying retrofit techniques to homes in the Whitehorse area.

The committee decided that it was necessary to have a prerequisite for entry into the course. Various options were considered, including an entrance exam, being a contractor and being a journeyman carpenter. As there was no clear definition of what a contractor is, and as an entrance exam would not ensure the course would not be filled with "do-it-yourselfers", it was decided that the journeyman carpenter status was the best. It would ensure that the trainees would be involved in housing construction and it was the easiest to administer. It was felt that any contractor who wanted to bid on the retrofit work should be able to pick up some of the graduates of the course if they were unable to do the work themselves. The requirement for journeyman also reflected the Department of Education training program's emphasis on journeyman papers. After having trained so many journeymen carpenters, the government felt it necessary to restrict admission to those who were certified. At the time there were 203 carpenters registered at the union office; 201 of them were unemployed.

In February, 1983 40 tradesmen in the Whitehorse area were notified of the course's inception, and of the journeyman-status entrance-requirement. If a tradesman had six years' experience in the carpentry field, but had not yet been certified, he was advised to contact the Industrial Training Coordinator for the necessary documentation.

The reaction to the journeyman status entrance requirement was immediate and negative. It was deemed unfair to exclude those who had invested considerable time, money and effort in the retrofit business even though they were not journeymen carpenters. Many contractors felt they did not have the time or did not need to attend a 20 day course which would make them eligible to bid on the retrofit projects. In addition to the contractors, Yukon Housing Corporation (YHC) felt that by insisting on the journeyman status many contractors would feel alienated and would not bother tendering. YHC felt the eligibility criteria ruled out many capable contractors who had previously performed in a very professional manner.

The committee was faced with the problem of adhering to its own stand on the issue while satisfying the needs of the protestors. It was felt that credibility would be lost if exceptions were made. Furthermore, allowing non-journeyman carpenters into the course would cause bad feelings amongst those already registered.

The topic of the entrance requirement entered the political arena and as a result some changes were made. The applicants for the training course had to either possess journeyman certification or pass an entrance exam based on parts of the journeyman's certification exam. To satisfy the contractors who did not have the time or did not need to attend a 20 day course, a three-day retrofitting techniques course was to be held the following month, May 1983.

The three-day course was to be given for information only in order to help the contractor understand the work on which he (or she) might decide to bid. This dismayed the Carpenters' Union, who felt that the government was abandoning principles the government itself enforced, in favour of interest groups which the Union felt had no commitment to the carpentry trade.

The three-day course was held in May to acquaint building contractors and sub-contractors with the state of the art techniques in building retrofits and new construction for energy efficiency. Principles of air leakage and sealing, interior and exterior retrofits, heating systems, construction materials and marketing were covered. The course was primarily theoretical with some on-site demonstration. It allowed contractors with CGSB listing to bid on the retrofit contracts on equal standing with the 20 day course graduates. The cost of the course was $6,376.

To be eligible to do the retrofit work on the Seniors' retrofit project the contractor had to meet the following criteria: (1) on work eligible for the federal CHIP and COSP programs, the contractor or sub-contractor doing the work must be listed under CGSB 51-GP-41; and (2) for all work, the contractor must either employ, on each construction site, a graduate of the April training course, or have attended the full three-day May workshop. In order to make the people who had attended the 20-day training course eligible for work on the Seniors' retrofit project, the process of giving them CGSB certification was given immediate and swift attention by the parties concerned in Ottawa and in Whitehorse. This also ensured that the homeowners could take full advantage of the COSP and CHIP programs. An exam was written mid-May, and CGSB listing process was done by the end of May, in time to allow the contractors to bid on the tenders on the retrofit project.

In the end, seventeen people attended the 20-day training course. Thirteen wrote the CGSB listing exam, and twelve passed it. Only two contractors actually became CGSB listed. Others felt it was too expensive an undertaking when the real beneficiaries would be the seniors who could claim expenses under COSP and CHIP. Of the 17 who attended the course, at least nine received some work through the seniors' project. For three of them it was virtually their only source of employment.

There were also 17 people who attended the three-day course, including contractors, individuals involved in energy conservation, and representatives of various government agencies.

The 20 day course was planned with the idea that it would run as a regular course on an annual basis until such time as it became unnecessary. It was meant to provide an adequate supply of qualified tradesmen to meet the increased demand for retrofitting visualized for the future. However the demand never materialized, consequently the need for the course ceased to exist and it has been offered only the one time.

The history of the retrofit training course was somewhat turbulent at times with the confusion regarding eligibility and the inception of the three day course as a quick response to political pressures. However, in the end the course did serve the purpose of training local tradesmen in the principles of retrofitting, while protecting the homeowners with a recognized standard of craftsmanship. All those who were interested and qualified had the chance to take one of the courses and to benefit from the work available from the retrofit project. It was a unique opportunity for upgrading skills and having the availability of directly-related work immediately following the courses. Any skepticism regarding retrofit work was replaced by an eagerness to utilize the new techniques in order to build better structures.

COURSE CONTENT

The group of consultants who delivered the course designed it with the purpose of providing the following elements to the participants:

- a sound theoretical background of air movement into and out of the home,
- a thorough understanding of the different retrofit measures applicable for upgrading energy-efficiency,

- "hands-on" experience with various retrofit measures, and
- an understanding of the implications of retrofit measures on the homeowner and on the larger marketplace.

The course was divided into five parts, with the bulk of it given in three stages which were related directly to the three levels of retrofit being done in the demonstration part.

The first part was a general introduction on thermodynamics, house heat loss, use of computer programs, energy audits, monitoring savings and an explanation of the various government programs (CHIP, COSP, etc.).

The second part, the low-level retrofit, focussed mainly on air-sealing and weatherizing techniques, with some attention given to making heating systems efficient. On-site work was done on these three aspects. Other topics included a general overview of products and techniques used in energy-efficient retrofitting.

The medium-level retrofit dealt with heat loss through windows, basements, ceilings, roofs/attics, and the upgrading of basement walls, ceilings and interior walls. Considerable on-site work was done in this phase.

The high-level retrofit provided a comprehensive look at major retrofit techniques, focussing mainly on exterior insulation and wrapping. Air tightness, air quality, and high efficiency heating systems were also covered.

The concluding part of the course provided the participants with an overview of marketing and sales, and techniques and strategies for dealing with prospective and past clients.

The course was one of the most ambitious and thorough training packages assembled for energy-efficient construction. The participants in the course were well prepared to directly enter the ensuing retrofit demonstration project. By offering such an extensive program YTG and CREDA hoped to ensure quality of workmanship, efficient construction practices, and less expensive retrofit measures with maximum energy savings.

PROJECT DESCRIPTION

The project began with the selection of the target audience which was established as senior citizens throughout the territory. There is a Pioneer Utility Grant of $480 available to senior citizens in the Yukon to help them with their utility payments, and it was the recipients of this grant who were contacted initially. Explanatory letters were sent out to 211 people in December 1982, and were followed by a second explanatory letter and/or telephone call. The purpose of this was to explain the project and familiarize the senior citizens with the concepts of energy efficiency, often quite foreign to them. It was suggested to them than an energy audit be done on their homes, at no expense to them, with the results of the audit being used as a basis for the final selection of homes to be included in the retrofit project. The audit also served to determine the specific work to be done on each home.

Of the 211 people contacted, 109 people refused the audit and 10 gave no response whatsoever. The remaining 92 people gave their approval for an energy audit to be performed on their homes. For those who refused the audit there were a number of reasons cited. Many felt their taxes would go up, that their houses would be too air-tight, that any retrofit work that needed doing could be done by themselves, or that the condition of the house did not warrant upgrading (i.e. was too dilapidated). Many felt they had already done what was necessary concerning energy conservation in their homes.

The audits were done in early 1983 under the auspices of the Enhanced

Conservation Assistance Program (ECAP). Each house survey took 2 to 3 hours to complete and gathered information on the type, form and age of the house, number of occupants during heating season, moisture content, DHW use information, heating source and requirements, insulation levels and construction details. The ECAP program took approximately forty-five minutes to run, given that the form was completed accurately.

However, the ECAP program was lacking in design and the data was later re-run using the HOTCAN (National Research Council of Canada) program in order to obtain a more accurate description of retrofit recommendations and savings. It was critical that the most accurate estimate of savings be obtained as in the Group one and two retrofits the homeowners' share of the costs was the lesser of half of the cost of the retrofit work or the expected first year's full savings after retrofit. The survey data, computer results, and personal observations were used in determining what level of retrofit work was most appropriate for each home. Depressurization tests were done to detect air leaks and to indicate where caulking or sealing had to be done. These tests were the most efficient and effective means of determining problem areas and heat loss locations.

Once the audits were complete, some senior citizens decided not to procede further with the project and refused to have any retrofit work done. Other reasons were cited such as the homeowner's seasonal absence or a lack of understanding of retrofit technology. This latter point, in conjunction with many seniors' distrust of government and government programs is of significant interest. This attitude of distrust engendered by actual or sympathetic experience is next to impossible to change, as it has been reinforced over time so as to become almost dogmatic. The foreigness of new technology such as retrofitting is also difficult to overcome, and attempts to educate the seniors through seminars and visual displays does not necessarily guarantee their acceptance.

Once the classification of necessary retrofit work was complete, contract packages were drawn up and put to tender. It was the duty of Yukon Housing Corporation to draw up the tender specifications on all the seniors' houses and complete the tendering process. They were to oversee the contractual relationship between homeowners and contractors, do inspections of all completed work and submit progress reports. The Department of Economic Development in turn agreed not to interfere with YHC's management duties. Its task was to set up homeowner contact and to ensure that adequate finances were available.

Although the project had not proceeded up to this point without problems, some serious problems arose at this stage. Tender prices for three of four Group three (rewrap work) homes were much higher than the CREDA program was able to justify on the basis of potential energy savings. The bids ranged from $16,800 to $34,800. Part of the reason was that the work was fairly new to local contractors; part was due to the fact that work was being tendered by the government. Some of the higher priced rewrap bids would have put the houses within the R-2000 Super Energy Efficient Housing Program requirements. By eliminating some of the less cost effective measures, such as below grade insulation in the basement, the price was rendered more reasonable.

Re-wraps were limited in cost to $17,000, keeping in mind the objective of demonstrating cost-effective high level retrofits. Anything over $17,000 would be the responsibility of the homeowner. On the Group three retrofits the homeowner was required to pay 30% plus $600, or $5,700 on $17,000. He/she was then eligible to recover up to $4,300 from the various government programs, such as CHIP, COSP, and CHRP.

The initial proposal used a figure of $10,700 for each major retrofit. It proved to be too low, partially due to escalating costs of materials and labour. During the summer the CHRP grant became defunct and the recoverable portion for the homeowner was reduced to $1,300. This may have resulted in three major retrofit jobs being cancelled.

Tenders for some medium (Group two) retrofits closed August 10. The response was very poor, and was a major concern for the management. The main reason was that by mid-summer there was plenty of work elsewhere. This general contractor disinterest meant further delays in the work until the spring 1984, despite the timetable outlined in the agreement between YTG and YHC to complete the projects in the summer and fall 1983. YHC felt that its management services were far in excess of $35,000, and decided to opt out when the 1983 season work was completed. YHC felt that had the management services been provided by the private sector the fee would have been substantially higher. Economic Development acknowledged YHC's contribution and assumed responsibility for the project management.

As a result a new form of contract tendering was pursued where the homeowner was named the general contractor. The homeowner was given a package containing a contract agreement, several copies of the retrofit measures recommended for their home, and a list of eligible contractors. The homeowner was advised to contact two or three contractors and obtain estimates. The choice of contractor was made by the homeowner, although it was subject to final government approval. This move was considered beneficial as removal of the government's presence meant that the administrative burden was reduced and lower prices could be offered as tender bids. The homeowner became directly involved in the process, stimulating greater interest and participation.

By the end of the 1983 retrofit work season homeowners were beginning to understand the thrust of the program and recognize its merits. Once they understood the theory of envelope caulking and of creating an environment that can be controlled most seniors became quite enthusiastic about participating. In most cases a spirit of cooperation developed amongst administrators, homeowners, contractors and construction workers alike.

RETROFIT WORK - PRIVATE HOUSES

OBTAINING SPECIFICATIONS

The original building survey and energy analysis was done by a consulting group which used the ECAP audit. Unfortunately the audit itself proved to be a source of some major problems.

There are, however, two factors which must be pointed out with respect to using computer printouts concerning energy loss, retrofit recommendations and cost/benefits. First, the printout is only as reliable as the input information and the computer program. Second, even when the printout is reliable, the validity of the computer predictions is still a matter of debate. The technology of using computers to predict energy savings is still new, but it is the best method available.

The ECAP program was found lacking in design as it did not allow for contingencies in a number of areas, such as envelope caulking, weather stripping, and the installation of insulating hot water blankets. For example, the professional cost for installing the insulation blanket was a flat sixty dollars but the program could not account for variations in costs caused by different tank sizes or styles, or their inaccessibility. The program results were too generalized to be of practical use. The program could not make allowances for payback periods longer than ten years, for wood heat or exterior rewraps, and it tended to exaggerate potential savings. As mentioned earlier, accurate prediction of savings was critical in determining the cost to the homeowner.

Despite the faults of the ECAP program, the survey portion was very useful as it provided a ready source of pertinent information on any given home. This data was later used by the consultant who drew up the retrofit recommendations. It was also through the survey and audit that many senior citizens became aware of the energy loss that could be corrected by simple retrofit measures. As the survey was done on a interview style often taking two to three hours, the auditor became acquainted with the seniors and gained their confidence. Many became convinced at this point, although some did refuse to have any work done after the audit.

The lack of useful information from the ECAP program made it difficult to recommend retrofit measures, especially the higher level retrofits. This in turn made it difficult for YHC to draw up detailed tender packages. The tendered prices for the first retrofit, especially the exterior rewraps, were substantially higher than anticipated. It was the necessary to re-tender the packages to obtain a more realistic cost, which caused delays in the start of actual work.

The data for each house was run again using a HOTCAN program. This program, plus an inspection of each home by an expert from the Energy Branch of YTG, resulted in a useful set of retrofit recommendations. This new procedure was time consuming, but proved to be more reliable.

PROBLEMS WITH TENDER PACKAGES

As stated in a previous section the response to the tender packages was disappointing and a number of reasons can be cited for this. The tender packages were late in coming out and many tradesmen and contractors had already accepted other work. For those who were available to submit bids the lack of detail on the specs made it difficult to estimate a reasonable cost. The first bids ranged from $16,000 to over $30,000 on some rewrap jobs, while the upper limit set by CREDA was $17,000. Because it was necessary to adjust these bids to the lower end of the scale, some contractors felt it wasn't worth their time or labour to bid any more. The novelty of retrofitting and lack of experience also contributed to the overpricing problems.

The contractors who did eventually do the retrofit work had their share of problems. As it was their first independent attempt at such work, there was a reasonable amount of trial and error. They had trouble hiring labour and often had to recruit untrained Unemployment Recipients, who for the most part were very short-term employees and required supervision.

With numerous delays caused by the tendering problems and an unpredictable labour supply, work completion dates stretched into late fall and winter. Work was inevitably discontinued because of cold weather and resumed the following spring. This included exterior finishing, trimming and painting. Understandably this caused some consternation and negative attitudes toward the project and government.

Lack of sufficient supervision resulted in less than quality work and government inspections often provided the only check. The technical consultant hired to draw up retrofit recommendations was also responsible for site supervision. There was often only one supervisor for six major and several minor projects in different parts of the city.

GROUP FOUR (a) GREENWOOD PLACE

This apartment building is actually composed of a 36 unit apartment comples (Greenwood Place) and an attached two storey house. The three storey apartment section was built in 1977 using standard 2 x 6 construction techniques. The attached house, known as Bishop's House, is much older, of unknown construction date, and was unheated and unused prior to the retrofit work.

The apartment complex was given a group two retrofit with weatherstripping done around the windows and balcony doors. The building received attic insulation, and the heating system was tuned.

The Bishop's House received a group three retrofit with an exterior wrap of the building and was given siding to match the rest of the structure. The work performed on the Bishop's House was identical in nature to that performed on the Alexander Street Residence and described in the following section.

The total cost of the level two work on Greenwood Place and the incremental cost of the energy retrofit work on the Bishop's House was $24,015.

Fuel consumption for the calendar year 1983 (pre-retrofit) for Greenwood Place was 9.84 litres per degree-day. Post-retrofit consumption for both buildings (now attached) was 7.91 litres per degree-day. Annual savings for a normal year (based on a heating oil price of $0.42/litre and 6988 degree-days) Are $5770. Simple payback is 4.2 years.

The above figures are somewhat misleading since the post-retrofit heated volume is 15 per cent larger than the pre-retrofit volume. Actual savings are in the order, then, of 23,800 litres, or $10,000 annually and the simple payback is 2.4 years.

GROUP FOUR (b) ALEXANDER STREET RESIDENCE

This 22-suite building was slated for a level three retrofit for several reasons. It is an older building of unknown age, built of 2 x 4 construction with inadequate insulation levels, RSI 2.1 in the walls and roof. The building is structurally sound, but needed replacement of the roof and siding anyway. An exterior retrofit causes the least disruption to the tenants. A 60% reduction in fuel consumption was estimated in the proposal for the project.

The retrofit work was done on the exterior walls by using the curtain wall method. The original siding was removed and a vapour barrier was placed on the outside of the wall. Support trusses were attached to the base of the wall to support a curtain wall of 2 x 4's. There was a space between the old wall and the new wall, allowing RSI 4.8 fibreglass batt insultion to be added. The resulting wall was a total of 12 inches wide, consisting of 2 sections of

2 x 4's with a four inch space in between. Total insulation value is RSI 6.9.

The original flat roof was replaced with a new trussed roof. The original roof consisted of 2 x 8 joists with four inch RSI 2.1 batt insulation on the floor of the joist space. A four inch air space was ventilated by soffit vents, which were not satisfactory in venting moisture. The traditional method of reinsulating this type of roof by putting styrofoam on the existing roof deck was given some consideration. However, an alternative method was chosen of building a sloped roof on the existing one, creating a proper attic space in which to put insulation and providing a continuous vapour barrier with the walls under the new trusses. The total cost was less than the styrofoam method and resulted in a more efficient and conventional roof. The new insulation level is RSI 9.1, with 12 inches of RSI 7.0 fibreglass having been added. The roof work cost $29,700, and is expected to result in a saving of 6,700 litres of oil, or $3,041 (1985). The simple payback on the roof work is 9.8 years.

The old multi-paned, double-hung windows were replaced with sealed, tight-fitting triple glazed windows. The old windows were RSI .35, the new ones RSI .53. The change of windows provided extra space because of the wider sills, and more light even though the rough opening remained the same.

The six doors were replaced with more thermally efficient models, bringing the RSI value to 1.8 from .5.

The basement walls were also upgraded, with the RSI value of 1.7 improved to 5.2.

A new ventilation system, with heat recovery by means of a glycol loop heat exchanger at 70 per cent efficiency, was installed to replace individual fans.

Fuel consumption was used as a measure of the effectiveness of the retrofit. However, oil is also used for domestic hot water heating as well as space heating. The domestic hot water system was changed from one utilizing tanks to a tankless coil system, therefore oil consumption for DHW will have increased due to increased inefficiency of the new system. However, for our purposes here, we have disregarded this and have assumed any drop in oil consumption to be the result of the retrofit.

The following table shows the fuel consumption records for the past three years. All the retrofit work was done on the building in the summer of 1983.

	No. of litres	Reduction in litres
1982 January - December	35,504	
1983 January - December	20,700	14,804
1984 January - December	13,966	21,538

The construction-year fuel consumption was down by 41% from the pre-retrofit year, and a 60% reduction was realized during the first full year after retrofit for a savings of $9,347 ($ 1984) at $.434/litre. The estimated 60% reduction in fuel consumption was in fact achieved, thereby successfully demonstrating the concept of major retrofit work. The cost of this retrofit work was $159,500. Assuming an annual savings of 20,000 litres, and an annual increase in the price of fuel of five per cent, the payback period is 13.5 years. The tenants of the building were puzzled at the scope of the project when they would have preferred more tangible improvements. However, in the end, they will not only benefit from living in a more comfortable building, but their standard of living can also be improved with the money saved and they can no doubt enjoy smaller rent increases over the years.

One piece of evidence with regards to the success of the project is that when the heating system broke down for twelve hours one day in December 1983, when the outdoor temperature was -20°C, the building maintained a comfort level quite acceptable to the residents and there was no threat of damage to the plumbing.

MONITORING

The importance of monitoring both before and after retrofit cannot be underestimated as it provides the only accurate assessment of the improved thermal performance of the house. It also enables an analysis of the efficiency of various conservation measures in different conditions.

Certain factors are critical for effective monitoring and they include the following: gross energy consumption, space heat consumption, DHW consumption, and the combined energy consumption of all domestic applicances. In the absence of any other monitoring the space heat consumption by itself can give the most general indication of the effectiveness of retrofit work.

Energy consumption for space heating can be affected by climate variations, which therefore must also be monitored, usually by means of a daily record of maximum-minimum temperatures. A continuous chart of the house interior temperature plus twice-daily house humidity level readings would make detailed analysis of conservation methods possible.

At an early stage of the project, during the ECAP audit, the auditors asked homeowners to sign consent forms allowing the CREDA officials to look at their fuel or electrical consumption records both before and after retrofit.

Initially heating cost comparisons and depressurization tests were going to be the only monitoring options, but other means were used as well. A device was installed on oil furnaces to measure the accumulated on-time of the pump, and the number of pump cycles. Information on the rate of oil usage can be used to get an accurate estimate of house energy use. A spring wound recorder was installed simultaneously to automatically record the indoor temperature for a seven day period. In the case of houses where supplementary heating systems were used, such as wood stoves or kerosene heaters, the homeowner was asked not to use them and was compensated financially for using the extra oil. Dampers for fireplaces or stoves were closed. In all other respects the occupants were encouraged to pursue their normal activities. Monitoring was done on 17 houses, 10 houses prior to retrofit, and 7 after retrofit.

Depressurization tests, or airtightness testing, where the house was depressurized by 50 Pa, were used for two purposes. They were done prior to the retrofit to most accurately determine where air leaks occurred, and the resulting detailed air leakage schedule indicated to the contractor where sealing had to be done. A second test after the retrofit was used as a monitoring device to determine the effectiveness of the sealing work. The tests were done on 24 houses altogether.

Depressurization tests were conducted with all chimneys and combustion air vents tightly sealed, and kitchen and bathroom exhaust vents left in their normally closed position. All doors and windows were closed normally. Air infiltration was measured at depressurizations of 5 to 50 Pa at intervals of 5Pa. For each house a report was generated consisting of: calculations of the volume and above grade wall area of the house, equivalent leakage area calculated at 10 Pa, a graph of the logarithm of leakage measured in litres per second versus the logarithm of pressure, and a calculation of the number of air changes per hour at 50 Pa. From this information, pre-retrofit and post-retrofit comparisons were made of air-leakage area and of air changes per hour.

DISCUSSION

In Appendix B, the results of our monitoring analysis are presented graphically. The ten figures, however, represent three overlapping populations.

Figures one through five contain analysis of data from all 38 houses which were retrofitted. Figures six and seven represent data analysis on the 22 houses for which reliable results from pre- and post-retrofit blower door tests were obtained. Figures eight through ten represent a smaller population of 18, or, those houses for which we had obtained complete pre- and post-retrofit fuel consumption data.

Fifty-eight per cent of the houses which were retrofitted received pre- and post-retrofit blower door tests. There is only one person in the Yukon who has the equipment and the expertise to perform blower door tests. Unfortunately, he was also one of the contractors most heavily involved in performing retrofit work on this project. As a result, it became logistically impossible to schedule two sets of tests on each house. Of the 16 houses which did not have both sets of tests three were outside of Whitehorse and could not be justified economically; of the remaining 13, the minority could not be scheduled, while in seven cases one of the two tests proved unreliable, usually because of meterological reasons.

For 48 per cent of retrofitted houses complete and reliable data on pre- and post-retrofit fuel consumption were compiled. Nine of the retrofitted houses use cord wood as the principal cource of heat, hence it was impossible to ascertain the needed fuel-consumption data. An unexpected problem cropped up which prevented reliable calculation of fuel data for the remaining 11 houses. The residents of these houses were accustomed to buying a certain amount of fuel, say $200 worth, at irregular intervals, and paying for their purchases in cash. (According to one fuel-delivery company representative, these seniors used the occasion as an opportunity to talk to someone, the fuel delivery, in effect, becoming a social event of that particular week.) Since they were not filling their tanks on these occasions there was no way to calculate exactly how much was being burned.

TABLE I

Age of House (years)	Frequency	Average Expenditure	Mean Annual Predicted Saving	Mean Simple Payback (years)
9 or less	10	$5100	$530	9.6
10 - 19	9	$6100	$510	12.0
20 - 29	6	$6000	$560	10.7
30 - 39	8	$6500	$490	13.3
over 39	5	$6600	$560	11.8

Tables I and II examine the data in terms of the age of the house. From Table I it can be seen that there was no real relationship between expenditure and predicted savings. Average simple paybacks, based on real expenditures and predicted savings, ranged from 9.6 years, for houses under ten years in age, to 13.3 years for houses 30 to 39 years.

TABLE II

Age of House (years)	Frequency	Mean Reduction in Fuel Consumption	Mean Annual Saving	Mean Simple Payback (years)
9 or less	4	28.4 %	$656	7.8
10 - 19	5	39.8 %	$839	7.3
20 - 29	4	26.1 %	$694	8.6
30 - 39	2	32.9 %	$1061	6.1
over 39	3	24.6 %	$699	9.4

For that sub-population with complete pre- and post-retrofit fuel consumption data, however, the results are more optimistic. Simple paybacks ranged from 6.1 years to 9.4 years, an indication that actual savings exceeded predicted savings in the majority of homes. This was true for all age groups and for all price groupings except those in excess of $10,000 (Figure 10, Appendix B).

The effectiveness of work designed to reduce air leakage is displayed graphically in Figures six and seven. There is very little which might be considered surprising here except for the apparently significant fluctuations in the various age groups. This is really nothing more than an indication, as can be seen from Figure 7, that the reduction in ELA is a function of the individual house. The housing population of Whitehorse is characterized by a greater range in diversity than might be found in southern centres. Log homes, in particular, are very difficult to seal without wrapping the whole building.

The forced lines generated by the computer program in Figure 7 are probably somewhat misleading. The 75 year old house indicated in the plot was a leaky log building unale to achieve any better than a 15 per cent reduction without a much greater expenditure. If this house were thrown out, a more representative pair of lines would show greater divergence as the age of the houses increased.

Figures nine and ten examine the housing population in terms of monies spent on the retrofit. Four categories are arbitrarily chosen: less than $3000; $3000 to $5000; $5000 to $10,000; and, over $10,000.

Forty four per cent of the retrofits cost between $3000 and $5000 and sixty-six per cent cost less than $5000.

TABLE III

Cost of Retrofit (dollars)	Frequency	Predicted Savings	Actual Savings	Mean Savings Value	Range of Payback (years)
under 3000	3	15.5 %	16.2 %	$477	0 - 6.3
3000 - 5000	9	21.7 %	29.6 %	$715	4.2 - 7.0
5000 - 10000	2	23.7 %	34.3 %	$1300	3.8 - 7.6
over 10000	4	47.9 %	43.3 %	$840	11.9 - 20.2

In three of the four cost groupings actual savings exceeded predicted savings. However, as is clear from Figure 10, in two of the four categories, actual and predicted savings were significantly different. This would appear to suggest that the auditing procedure is both inaccurate and conservative for the north.

On the other hand, major retrofits achieved savings 4.6 per cent lower than predicted. This group is, in fact, quite interesting.

As can be seen from Table III, they achieved the greatest savings as a function of per cent of previous fuel consumption, but the value of their savings was only slightly in excess of the savings for retrofits costing $3 - 5000. Each of the four houses in this group is quite small. One was a 19 year old log house which achieved a reduction of nearly 60 per cent. Two, however, were relatively efficient houses, and the retrofit work probably could not have been justified on the basis of cost alone. However, the owners were prepared to invest in their homes and counted such intangibles as comfort, resale value and aesthetics among the benefits to be accrued.

These factors, while very real to those involved in this project, have, of course, not been included in this analysis, but ought not to be disregarded in the overall equation.

BUDGET REVIEW

CREDA CONTRIBUTIONS

Community Liaison		
Travel & expenses (auditors)	$ 5,034.00	
Telephone contacts	340.00	
	5,374.00	5,374.00
Advertising & Information Transfer		3,356.00
Training		
20 day course	35,156.00	
3 day course	6,376.00	
	41,532.00	41,532.00
Technical Consulting	8,000.00	8,000.00
YHC Retrofits (Group 4) CREDA contributions		
Alexander	102,000.00	
Greenwood	14,015.00	
Bishop's House	10,000.00	
	126,015.00	126,015.00
Private Homes - CREDA contributions		
Groups one and two	105,580.00	
Group three	74,922.00	
	180,502.00	180,502.00
Monitoring		
Infiltration Testing	11,900.00	
Travel & Expenses	2,220.00	
	14,120.00	14,120.00
Total		378,899.00

RETROFIT COSTS BREAKDOWN

Group two retrofit costs (31 homes)

CREDA contribution	105,580.00
Homeowner contribution	13,374.00
Total	118,954.00

Group three retrofit costs (7 homes)

CREDA contribution	74,922.00
Homeowner contribution	40,532.00
Total	115,454.00

Group four YHC Apartments:

Greenwood Place & Bishop's House

CREDA contribution	24,015.00

Alexander Street Residence

CREDA contribution	57,500.00
YHC contribution	102,000.00
Total	159,500.00

ENERGY ANALYSIS

Building	Expenditure	Annual Saving	Payback (years)
Greenwood/ Bishop's House	$24,015	$5770	4.2
Alexander Lodge	$159,000	$9347	17.0
Group II Houses	$118,954	$23,770	5.0
Group III Houses	$115,454	$5880	19.6
Total	$417,423	$44,768	9.3

ECONOMIC BENEFITS

The Seniors' project had many direct and indirect economic benefits both for the seniors themselves and for the communities in which they live.

The project resulted in better quality housing whether it be private homes or apartment units. In most cases windows were either upgraded to triple-paned with acrylic glazing or replaced with new units, doors were replaced with better ones and attic insulation was added. The houses are more energy efficient. The occupants have a more comfortable indoor environment. Problems with drafts, dry air and condensation were ameliorated, if not eliminated.

Savings on space heating costs are a direct benefit to the homeowner, but the financial implications of this are far-reaching as the money saved stays in the territory, instead of going south to the oil companies. Money formerly spent on heating costs can now be spent locally.

The business community was able to capitalize on the Seniors' program in several ways. Local building material suppliers benefitted from the increased demand for lumber, insulation etc. Local contractors received work not only for the actual retrofit work, but also for other aspects such as energy audits, consulting and airtightness testing. It was estimated that over 380 person weeks would be involved in the retrofit work itself.

POTENTIAL FOR REPLICATION

There is great potential for the replication of a project of this nature as there are only a very few houses or buildings which require no application of energy conservation methods whatsoever. A successful replication of a retrofitting program requires not only a supply of houses, but also a number of tradesmen qualified in retrofit construction techniques. The training course did in fact ensure this criterion and established the means for delivering similar courses in the future if necessary.

The Seniors' project has created a definite interest in the concept of retrofitting. Several individuals requested more information on participation in a similar type of project having seen the benefits of the retrofit work.

Considering the fact that retrofitting a home will help save our valuable non-renewable energy resources at a cost less than the cost of producing new energy supplies, it becomes a worthwhile endeavour. For the goals of conservation to continue beyond this project there is a need for people with energy-use assessment skills, building skills, the supply of materials and some funding in the form of government loans or grants. Financial assistance is available in the form of a $1,500 interest free loan, called SEAL, from YTG, and the federal government RRAP and CHIP grants described earlier.

There are still barriers to conservation, such as unwillingness to change, lack of information on energy use, conservation techniques, and the financial implications such as cost/benefits, but perhaps the success of the Seniors' program will be a stimulus to ongoing retrofit activity.

In 1984, according to the Yukon Economic Review, building permits were issued for 183 residences for a total of $1,785,000 worth of work. Of these 15, or 8%, were for new housing starts, leaving 168 or 92% for renovations or improvements. With such a large percentage of the work being renovations or improvements there is great potential for the retrofit industry.

Conservation is now regarded as an energy supply option as it is cheaper to conserve than it is to produce. In his 1984 report, the Economic Impact of Selected Energy Sources in Yukon, Marvin Shaffer and Associates lists insulation and air sealing as energy forms along with what we regard as the conventional forms such as heating oil, electricity, wood, solar and wind energy. Insulation and air sealing rank the two lowest in terms of capital expenditure impact per annual GJ. This is because of very low costs per output GJ, where output GJ is in fact GJ saved. In other words the cost per GJ for insulation and air sealing is less than that for the other conventional production methods.

CONCLUSIONS

There are two crucial tasks invovled in significantly upgrading the energy efficiency of an existing housing stock: firstly, it must be demonstrated to the general public and to government that the construction work is effective in saving energy; and secondly, to ensure the first point, the skill levels of tradespeople must be continually upgraded. Energy conservation construction is dynamic with new and improved products entering the market each year and new techniques being developed which make the work simpler and more cost effective. If tradespeople do not stay on top of these developments they will lose their competitive advantage. More serious, their work, if it cannot deliver on energy-efficient promises, may have deleterious ramifications on the industry as a whole. This point lays out a role for government, both as the inspector of construction projects and as the agency for delivering upgrading projects.

The Seniors Retrofit Project was successful in achieving its objectives of demonstrating the effectiveness of a range of energy conservation measures in various types of housing units of senior citizens and of training local tradesmen and contractors in energy efficient construction techniques. The importance of these methods were made aware to consumer and carpenter alike, one through the demonstration, the other through the training part. It is hoped others will become interested in this type of conservation work through the satisfied participants.

The project was instrumental in improving the quality of a number of homes and two apartment buildings. It facilitated in conserving energy, thus helping to reduce our dependence on expensive imported oil. The resulting lower heating bills will keep more money in the Yukon and will contribute to a better lifestyle for the project participants. It made individuals aware of energy use and conservation, and established a core of tradesmen and contractors versed in retrofit techniques, establishing a reliable industry instead of "fly-by-nighter".

The project was a success as judged by homeowner attitudes which are equally as important as the non-human aspects. Although there was some dissatisfaction expressed due to delays in retrofit work or in receiving grant money, many seniors were very satisfied with the quality of workmanship and with the resulting savings.

The project provided a boost to the generally depressed economy through the jobs it created, the trade for local building material suppliers and the dollars saved in heating costs.

There were a number of problems normally associated with the implementation of a pilot project. The major problems were the immense size and scope of the project, exacerbated by the particular audience selection. Other problems, more minor in nature, arose with qualifications for the training program, retrofit specifications, tendering process and some actual retrofit work, but they were solved by various appropriate measures. A certain number of problems are going to arise in any large pilot project, but with satisfactory solutions having been found the problems were not detrimental to the project.

RECOMMENDATIONS FOR SIMILAR PROJECTS

The Seniors Project was a pilot project, being the first of its kind in Canada, and as such had its share of unforeseen problems. As there is always the possibility of a project similar in nature or scope, the following list of recommendations may be appropriate.

1. Project participants should be those who apply. This would eliminate attitudinal problems caused by feelings of the project being imposed on people. The reverse tactic of having people apply would ensure an interested group and a two-way flow of interest instead of the feeling of the project being imposed on people. The government could at the same time set some of its own limits if necessary.

2. A consumer education course could be offered prior to the project to increase awareness of energy conservation, retrofit measures and cost/benefit analysis. This was done by the instructors of the 20 day training course; details are in Appendix A.

3. Use of more detailed audit, costing more than $30 each. The audit was good, however, for marketing the program; many became convinced at this point. A well-planned audit would facilitate in drawing up retrofit specs and tender packages.

4. Homeowners should have contracted the work. This would have given them more direct involvement, decreased administrative needs and eliminated the government as a third party.

5. More than one estimate should be required to insure the best price for the homeowner.

6. There should be adequate manpower to supervise the retrofit work and oversee the project. YHC found there was often one person to oversee several major and minor projects in different parts of town.

7. Methods of monitoring and the items to be monitored should be known well in advance. Pre-retrofit data is just as essential as post-retrofit data and it should be obtained.

8. Proper planning of the initial energy audit and the monitoring will greatly facilitate in the analysis of data and the evaluation of the project results.

APPENDIX A

Energy Know-How Seminars

APPENDIX A

Energy Know-how Seminars

In the spring of 1983, prior to the retrofit work, a series of five seminars were given by the instructors of the 20 day training course. These seminars were offered to the general public and contained a wide variety of the latest ideas and methods for saving energy and money in and around the home, both for retrofitting and for new construction.

The topics covered in the sessions were as follows:

1. Seal Your Home First - Tightness, air quality and air management - by Sebastian Moffatt.
2. Super-Insulated Retrofits - Energy efficient renovation of your home - by Brian Marshall.
3. Solar - Does It make Sense? - Solar and new house construction, Solar retrofit and greenhouses - by Chris Mattock.
4. Build With Energy Efficiency in Mind - New house construction, Air to air heat exchangers - by Oliver Drerup.
5. Recent Innovations in Construction - An overview of new building techniques around the country - by Keith Hanson.

The seminars were well attended, with a total of approximately 250 people for all five sessions.

APPENDIX B

Graphs

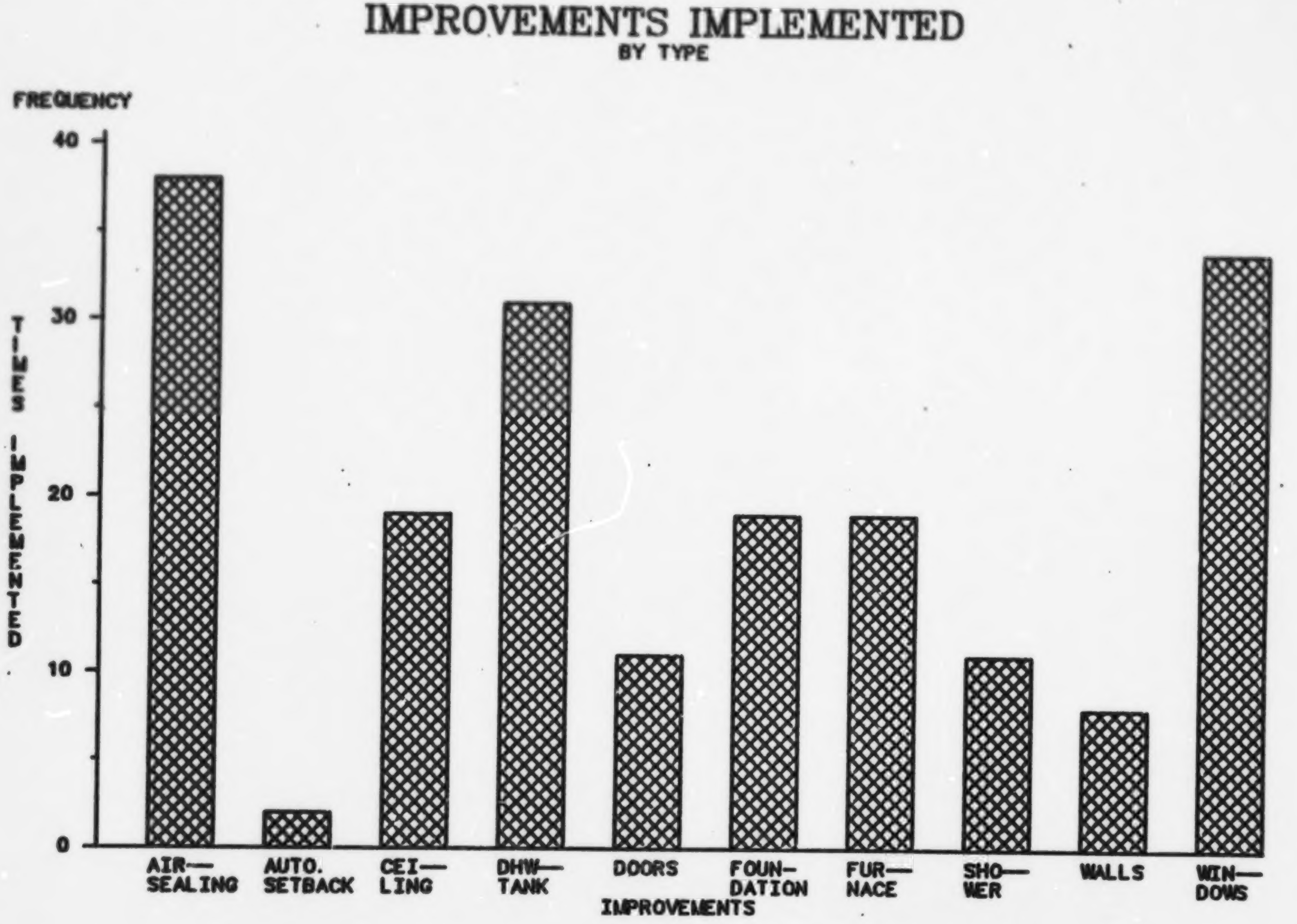

IMPROVEMENTS IMPLEMENTED
BY TYPE
FREQUENCY
TIMES IMPLEMENTED
40
30
20
10
0
AIR—SEALING
AUTO. SETBACK
CEI—LING
DHW—TANK
DOORS
FOUN—DATION
FUR—NACE
SHO—WER
WALLS
WIN—DOWS
IMPROVEMENTS

FIGURE 1

SENIORS HOUSES AUDITED

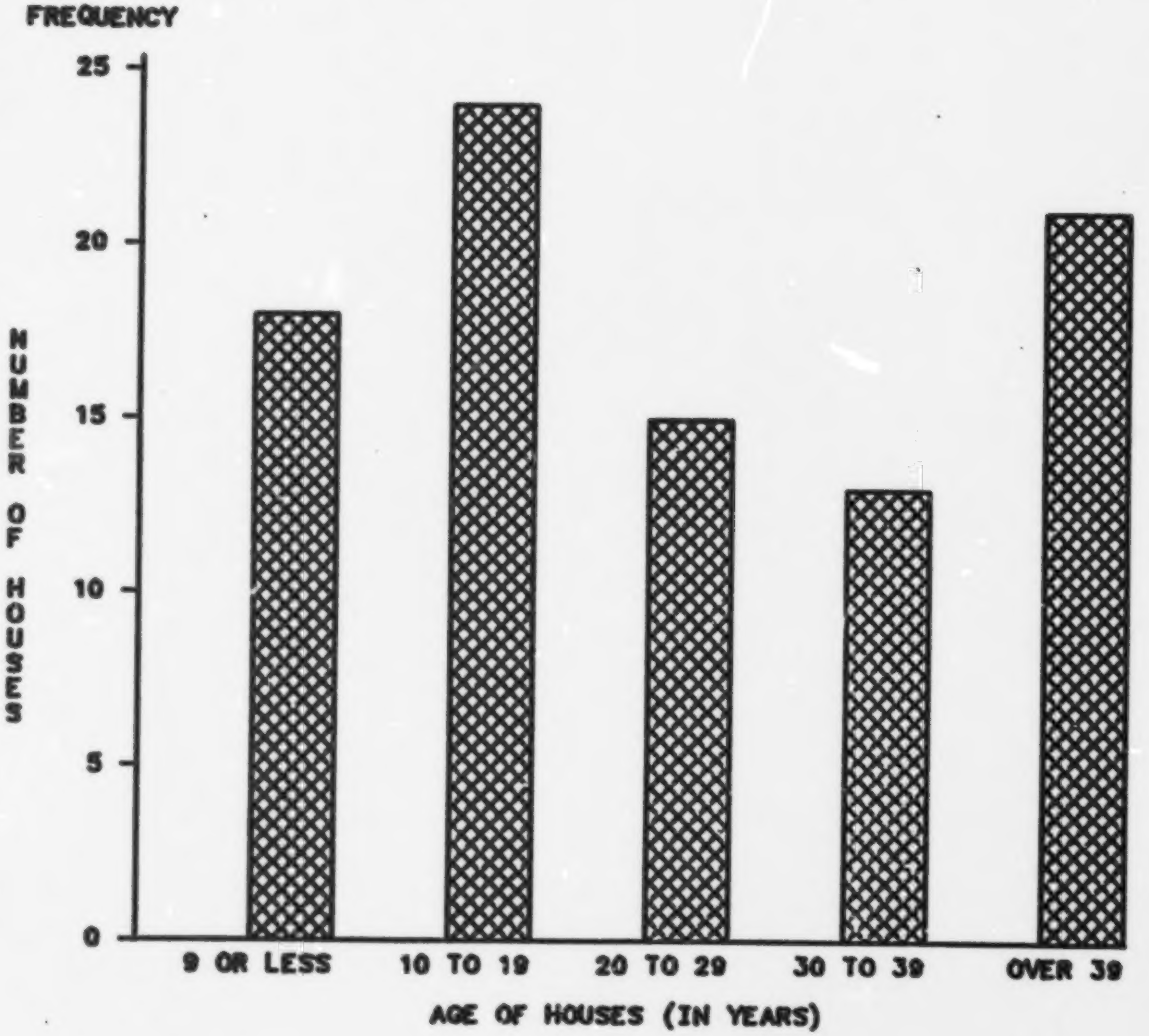


FIGURE 2

SENIORS HOUSES RETROFITTED

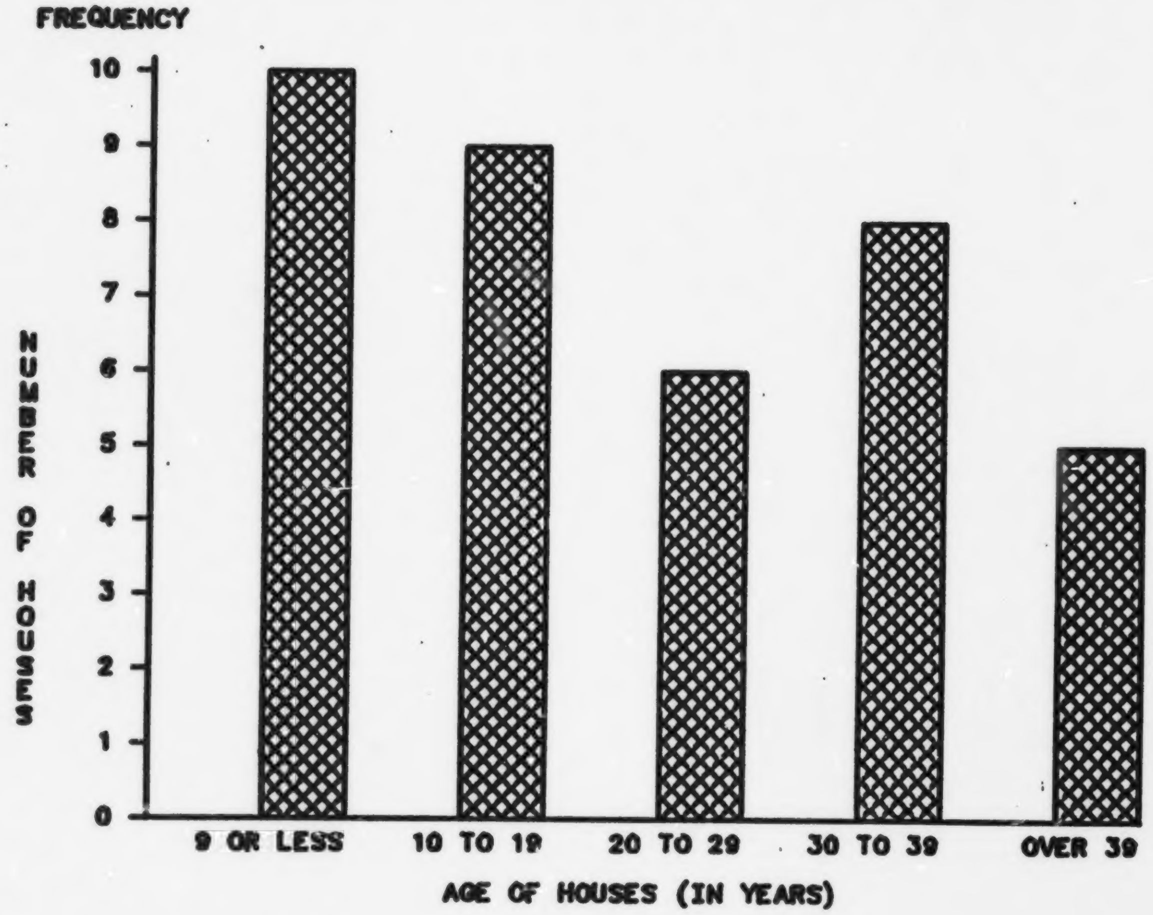


FIGURE 3

AMOUNT SPENT ON RETROFITS

CREDA AND HOMEOWNERS

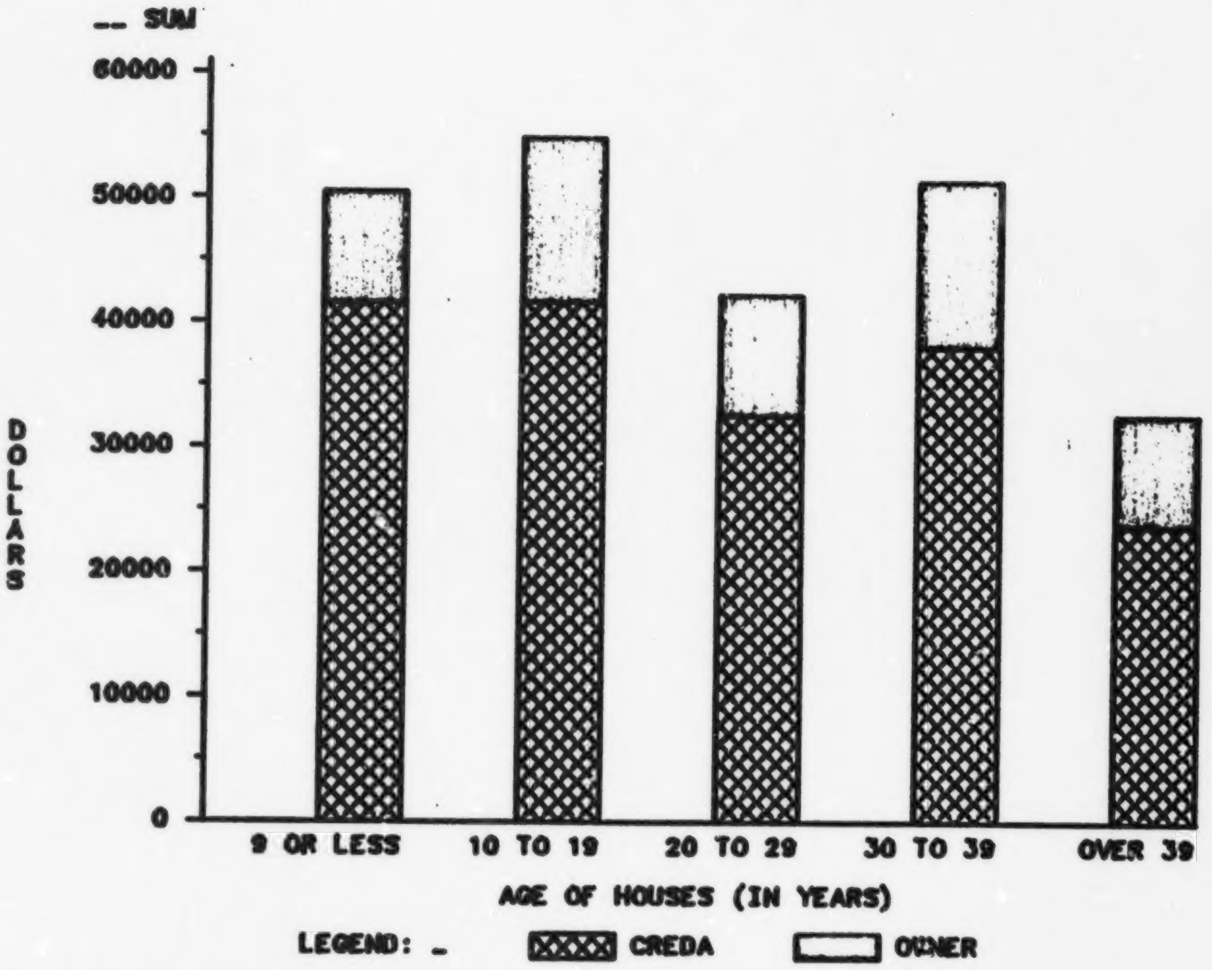


FIGURE 4

PREDICTED ANNUAL SAVINGS

ON HOUSES RETROFITTED

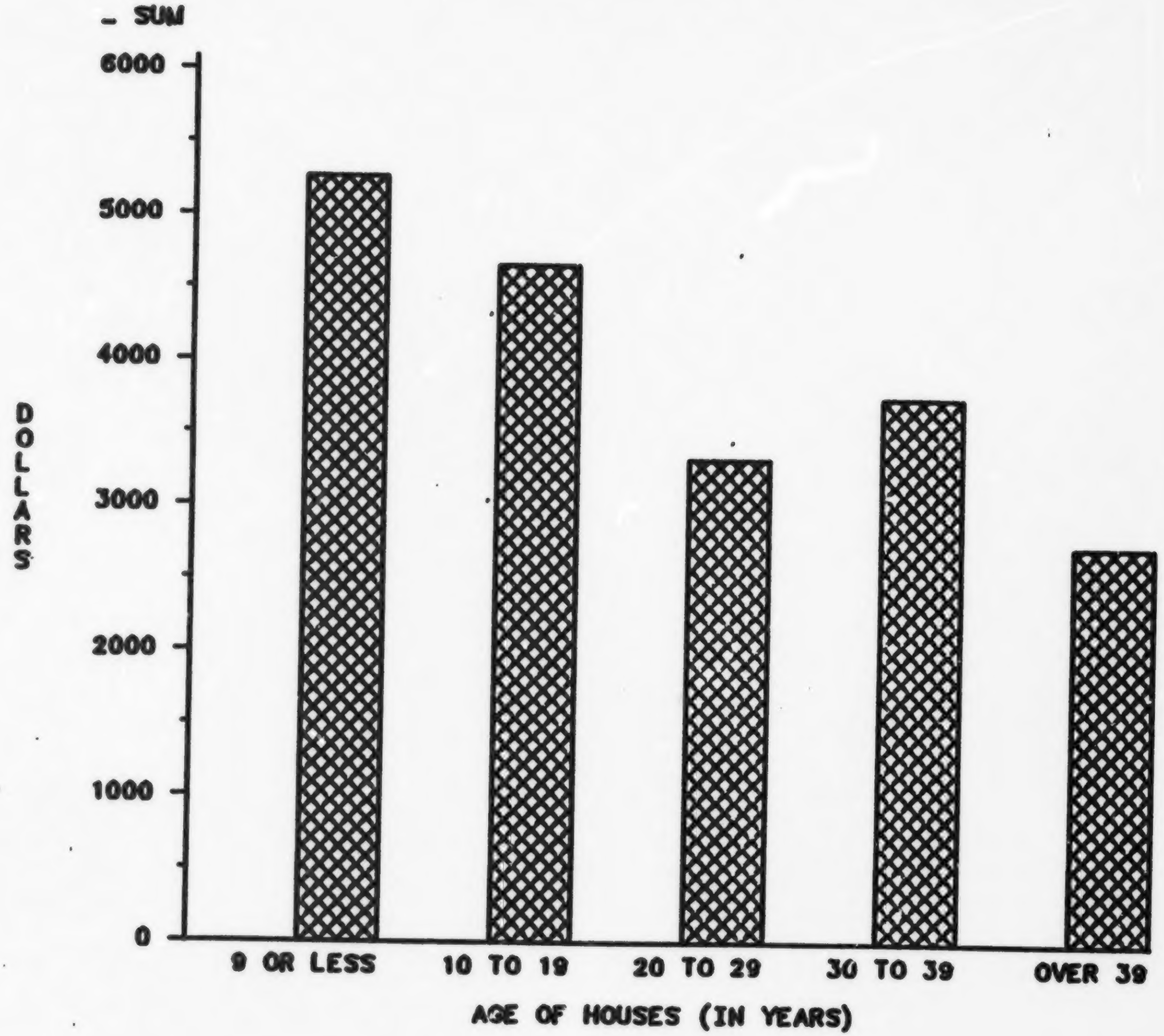


FIGURE 5

AVERAGE REDUCTION IN AIR LEAKAGE
(AREA OF EQUIVALENT AIR LEAKAGE)

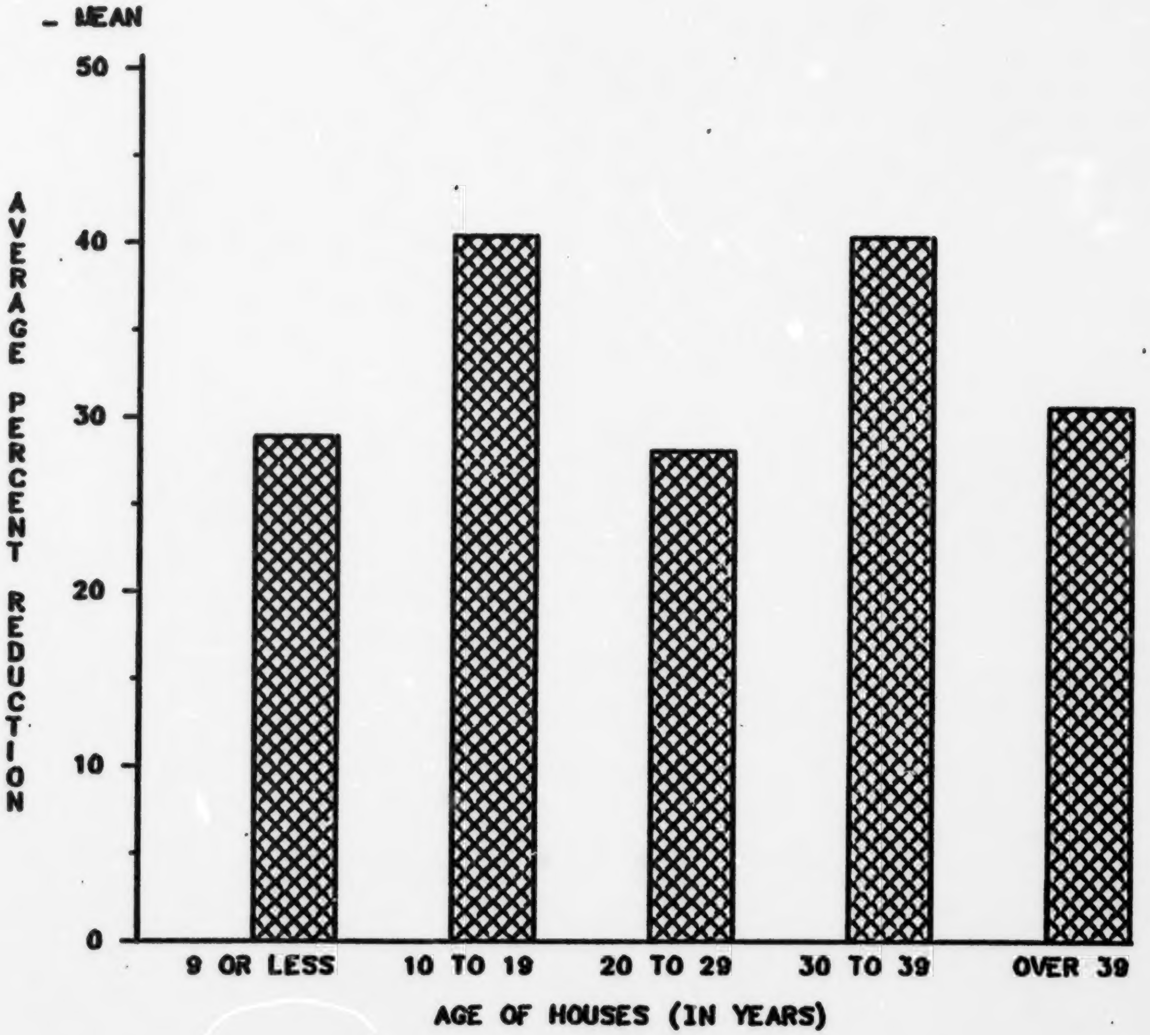


FIGURE 6

AIR LEAKAGE VERSUS AGE OF HOUSE

BEFORE AND AFTER RETROFIT

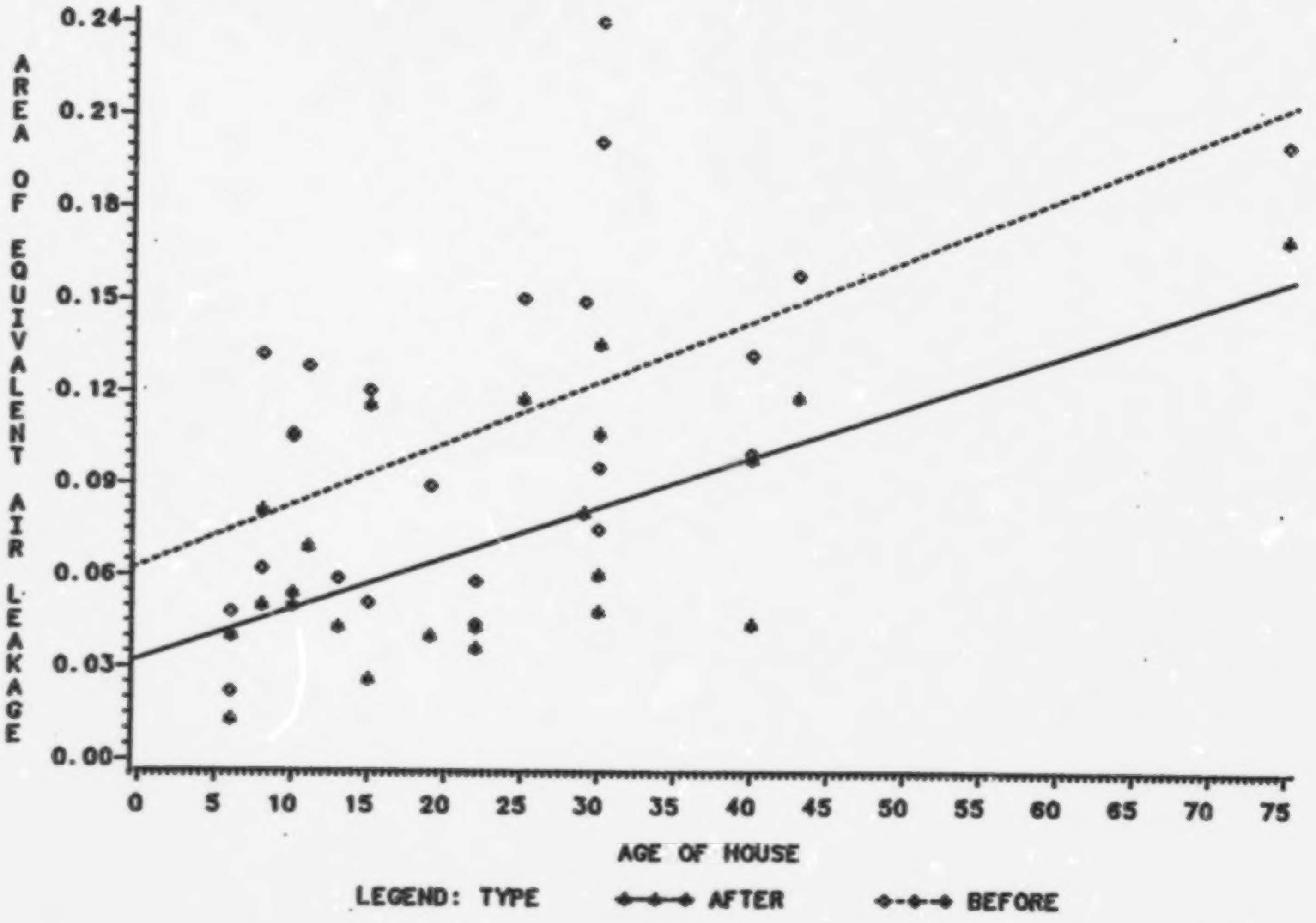
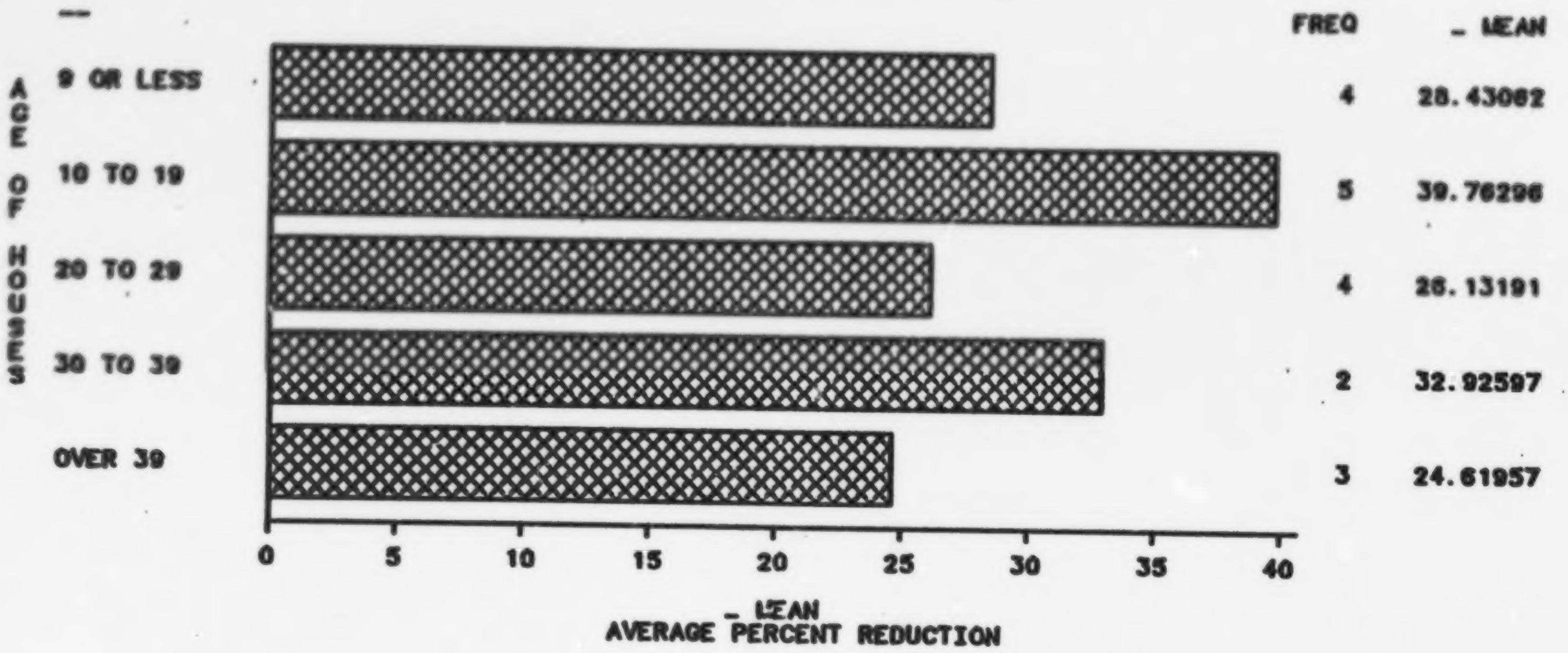


FIGURE 7

AVERAGE REDUCTION IN CONSUMPTION

(KILOWATT HOURS PER DEGREE DAY FOR SPACE HEATING)



FREQ	_ MEAN
4	28.43062
5	39.76296
4	26.13191
2	32.92597
3	24.61957

FIGURE 8

PROFILE OF RETROFIT COSTS

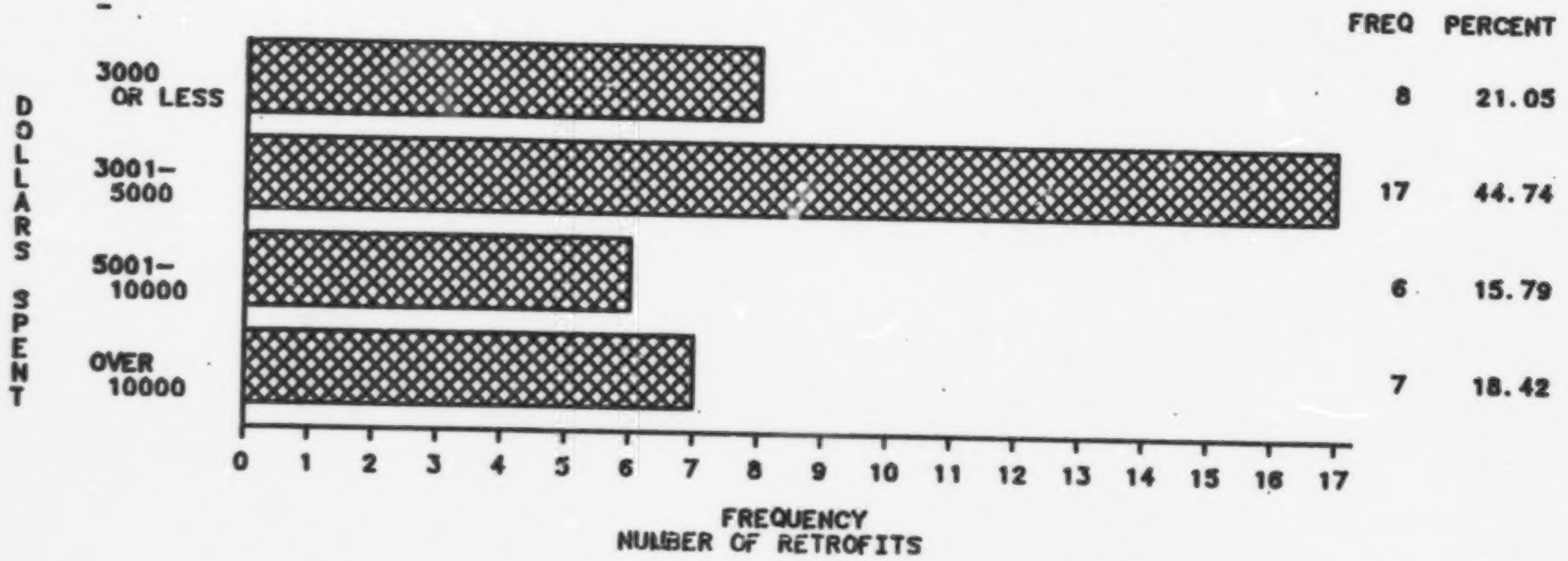


FIGURE 9

PROFILE OF ANNUAL SAVINGS
ACTUAL AND PREDICTED

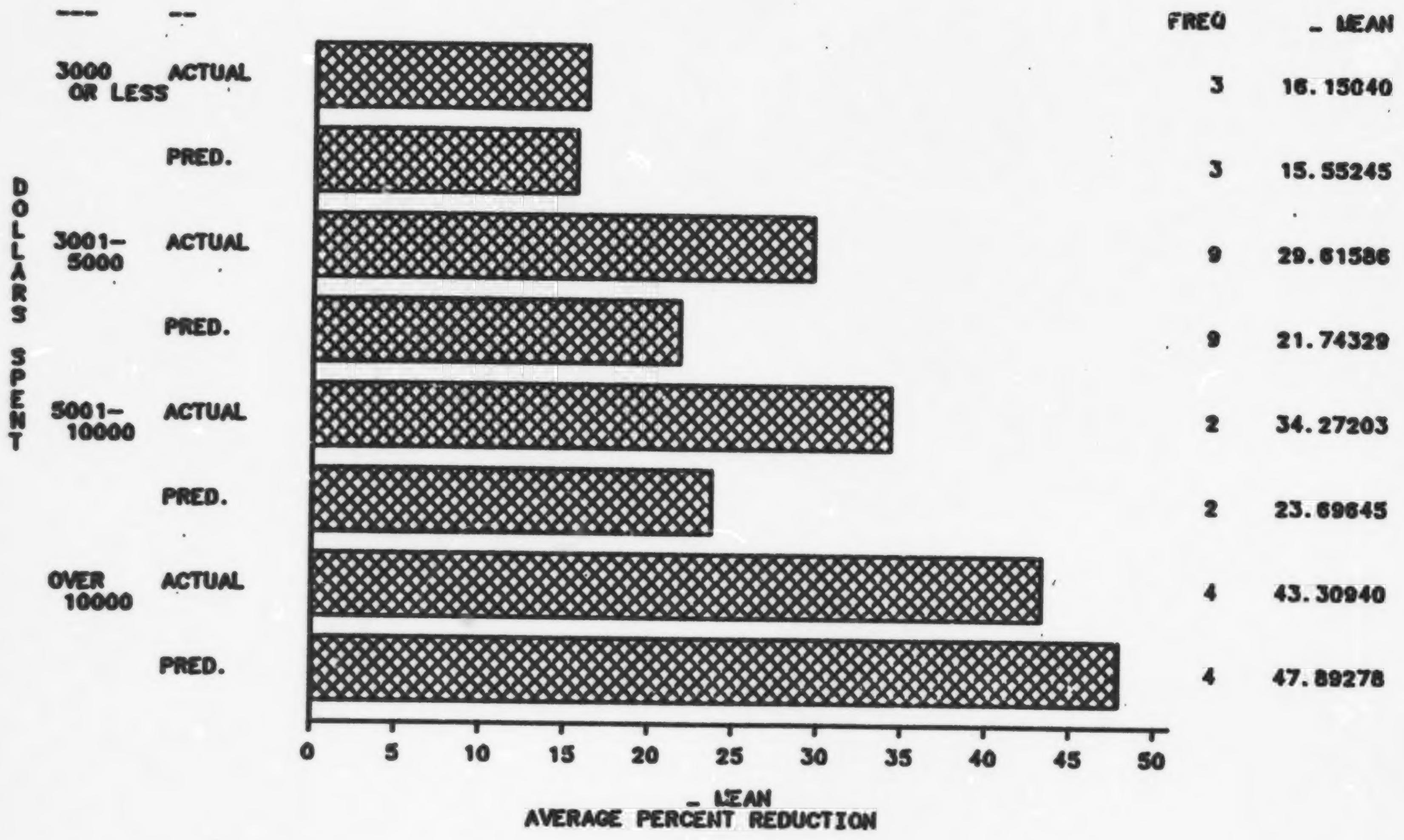


FIGURE 10

APPENDIX C

Client Fact Sheets

CLIENT FACT SHEET

CLIENT NUMBER: RIV 0001249

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION:

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$380	HOMEOWNER	$380
CREDA	$3,280	CREDA	$3,280

EXPECTED SAVINGS: $380 ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - envelope caulking to seal air leakages.

- window upgrading, magnatherm glazing.
- 3.5 RSI addid to attic.
- insulate DHW tank.

MONITORING: Pre and post retrofit electricity consumption records.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY	$989	
FUEL OIL		
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: AFTER: 4.11 % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: AFTER: 0.80 % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- no problems noted.	
- noted melted snow around slab foundation.	

CLIENT FACT SHEET

CLIENT NUMBER: WHS0006060

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 13 year old, one storey wood frame house, two apartments located in basement. 610 m^3 area.

ESTIMATED COST:
HOMEOWNER $310
CREDA $3,100

ACTUAL COST:
HOMEOWNER $310
CREDA ~~$3,100~~ $1,405

EXPECTED SAVINGS: $310

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS:
- envelope caulking to seal air leakages
- upgrade windows, add magnatherm glazing to main floor, east/north/west facing windows
- insulate DHW tank

MONITORING: Participant in pre-retrofit monitoring program pre and post retrofit heat consumption comparison, record indoor/outdoor temperature, humidity, and furnace operation recording for one month period commencing 84/02/28.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	7,380 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)
BEFORE: 7.66 AFTER: 6.09 % REDUCTION 20.4

AIR LEAKAGE L/m^2/sec.
BEFORE: 2.62 AFTER: 2.08 % REDUCTION 20.6

HOMEOWNER COMMENTS:

BEFORE	AFTER
- reports no significant problems - furnace is water boiler type and gives off excessive waste heat in furnace room area.	

CLIENT FACT SHEET

CLIENT NUMBER: SAH LOBD 025

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: An 11 year old mobile home with summertime addition. Slab on grade foundation. 140 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 260	HOMEOWNER	$ 260
CREDA	$3,404	CREDA	$3,404

EXPECTED SAVINGS: $260 ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS:

- envelope caulking to seal air leakages
- window upgrading, magnatherm liners
- furnace servicing

MONITORING: Post retrofit monitoring; pre and post heating cost comparison; record indoor/outdoor temperature, humidity, and furnace operation one month period commencing 84/02/22.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$380	
WOOD (m^2/cords)	$300	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 17.0 AFTER: 10.86 % REDUCTION 36.1

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.12 AFTER: 1.99 % REDUCTION 36.2

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems - heavy window fogging	- window fogging and icing (caused by ill-fitting magnatherm glaxing, now corrected)
- drafts	- complaint of air tightness (test reveal adequate air change)
- cold rooms	- complaint of bathtub trap freezing (caused by owner's wish to delete skirting insulation called for in specs.)

CLIENT FACT SHEET

CLIENT NUMBER: RIV0025237

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: An 8 year old, one storey house, wood frame over full basement, 520 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 550	HOMEOWNER	$ 550
CREDA	$5,550	CREDA	$5,550
EXPECTED SAVINGS:	$550	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: - envelope caulking using blower door
- upgrade main attic with 3.5 RSI
- upgrade windows - add magnatherm glazing to all existing slider windows except south facing ones
- upgrade main floor - 1½" styrofoam to exposed joist cavaties
- insulate DHW tank

MONITORING:

Pre and post retrofit heating consumption comparison

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY	$1,017	
FUEL OIL		
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE:	3.59	AFTER:	3.10	% REDUCTION	13.6

AIR LEAKAGE L/m^2/sec.

BEFORE:	1.90	AFTER:	1.64	% REDUCTION	13.6

HOMEOWNER COMMENTS:

BEFORE	AFTER
- problem with drafts	

CLIENT FACT SHEET

CLIENT NUMBER: PCK 0859000

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 15 year old one storey mobile home. Retrofitted roof and three walls, plus addition. 198 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 260	**HOMEOWNER**	$ 260
CREDA	$2,640	**CREDA**	$2,900
EXPECTED SAVINGS:	$260	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS:
- envelope caulking (homeowner not interested in having all leaks sealed)
- door weatherstripping
- magnatherm liner, window upgrading
- insulate DHW tank

MONITORING: Pre and post retrofit heating cost comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)	$340	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 14.09 **AFTER:** 13.86 **% REDUCTION** 1.6

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.97 **AFTER:** 2.93 **% REDUCTION** 1.3

HOMEOWNER COMMENTS:

BEFORE	AFTER
- problem with moisture; foggy windows	
- cold rooms	

CLIENT FACT SHEET

CLIENT NUMBER: DAW 0001 OLC

LOCATION: Dawson City

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 12 year old single width trailer with a crawlspace. 203 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$535	**HOMEOWNER**	$535
CREDA	$5300	**CREDA**	$4765

EXPECTED SAVINGS: $535 **ACTUAL SAVINGS:**

RETROFIT TECHNICAL DETAILS: Air sealing by caulking and weatherstripping; DHW tank blanket furnace servicing; add magnetically sealed acrylic glazing to windows; add air barrier to trailer skirting; repair kitchen and bathroom fans; add RSI 1.2 fibreglass insulation and vapour barrier to ceiling.

MONITORING:

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	4267 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: **AFTER:** **% REDUCTION**

AIR LEAKAGE L/m^2/sec.

BEFORE: **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**

CLIENT FACT SHEET

CLIENT NUMBER: RIV 0014 203

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 22 year old wood frame one-storey house with full basement. 436 m^3 area.

ESTIMATED COST:
HOMEOWNER $445
CREDA $4198

ACTUAL COST:
HOMEOWNER $445
CREDA $4198

EXPECTED SAVINGS: $445

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - Caulking and weatherstripping; insulation blanket in DHW tank, low-flow shower head, lower DHW tank setting; furnace servicing; upgrade attic insulation to RSI 10.6; upgrade exterior front and back doors.

MONITORING: Pre and post retrofit monitoring with air-tightness test and comparison of space heating costs.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	~~AFTER~~
ELECTRICITY		
FUEL OIL	1386 L	
WOOD (m^2/cords)	4 cords	

AIR CHANGES PER HOUR (@ 50 Pa)
BEFORE: 3.60 AFTER: 2.81 % REDUCTION 21.9

AIR LEAKAGE L/m^2/sec.
BEFORE: 2.82 AFTER: 1.78 % REDUCTION 36.8

HOMEOWNER COMMENTS:

BEFORE

AFTER

CLIENT FACT SHEET

CLIENT NUMBER:

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: Mobile home, slab on grade, approximately 6 years old. $184m^3$ area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$270	HOMEOWNER	$270
CREDA	$2700	CREDA	$1705
EXPECTED SAVINGS:	$270	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS: - envelope caulking to seal all air leakages; door weatherstripping; upgrade windows with magnatherm liners in living room, kitchen, hallway, patio door and bedrooms; insulate DHW tank.

MONITORING: Participant in pre-retrofit monitoring program; pre and post retrofit heat consumption comparison, record and indoor/outdoor temperature, humidity, and furnace operation for one month commencing 84.02.24.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	2505 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 8.06 AFTER: 6.8 % REDUCTION 15.6

AIR LEAKAGE $L/m^2/sec.$

BEFORE: 1.51 AFTER: 1.28 % REDUCTION 15.2

HOMEOWNER COMMENTS:

BEFORE	AFTER
- drafty doors.	
- window fogging (homeowner has already done some caulking on windows.)	

CLIENT FACT SHEET

CLIENT NUMBER: WHS0244000

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A one storey log house, approximately 70 years old. Moved to present site and set on full basement. Wood frame addition.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 245	HOMEOWNER	$ 400
CREDA	$2,450	CREDA	$3,432
EXPECTED SAVINGS:	$245	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:

- envelope caulking to seal air leakages
- upgrade windows, magnatherm liner in pantry and north bedroom
- insulate DHW tank

MONITORING: Participant in pre-retrofit monitoring program; comparison of pre and post retrofit heat consumption, record indoor/outdoor temperature, humidity, and furnace operation for one month commencing 84/02/24.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$1,124 2,850 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 17.4 AFTER: 15.23 % REDUCTION 12.4

AIR LEAKAGE L/m^2/sec.

BEFORE: 8.66 AFTER: 7.58 % REDUCTION 12.4

HOMEOWNER COMMENTS:

BEFORE	AFTER
- major heat loss through addition roof; ices up in winter	
- other heat loss through log walls	

CLIENT FACT SHEET

CLIENT NUMBER: WHS 0002 070

LOCATION:

TYPE OF RETROFIT:

HOUSE DESCRIPTION: A 30 year old one-storey wood frame house with a combination crawl space and full basement. 320 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$320	**HOMEOWNER**	$320
CREDA	$2070	**CREDA**	$2522
EXPECTED SAVINGS:	$320	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: Air sealing by caulking and weatherstripping; install low flow shower head and DHW blanket; set DHW temperature at 50°C; boiler servicing, install insulated exterior back door; add acrylic glazing to windows.

MONITORING:

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY	no data	
FUEL OIL	no data	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 13.00 **AFTER:** **% REDUCTION**

AIR LEAKAGE L/m^2/sec.

BEFORE: 5.92 **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**

CLIENT FACT SHEET

CLIENT NUMBER: PCK 0218 000

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 19 year old, one storey house wood frame with full basement, 460 m^3 area.

ESTIMATED COST:	ACTUAL COST:
HOMEOWNER $195	HOMEOWNER $400
CREDA $1950	CREDA $3163
EXPECTED SAVINGS: $195	ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS:
- envelope caulking (using blower door)
- door weather stripping
- upgrade basement windows
- upgrade basement - 1½" R7.5 styrofoam to exposed joist header area.

MONITORING: Pre and post retrofit heat consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	2410 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 6.58 AFTER: 3.20 % REDUCTION 51.3

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.34 AFTER: 1.62 % REDUCTION 51.5

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems	
- drafts	

CLIENT FACT SHEET

CLIENT NUMBER:

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 25 year old wood frame one storey house with full basement. 481.5 m^3 area.

ESTIMATED COST:
HOMEOWNER $ 450
CREDA $3,885

ACTUAL COST:
HOMEOWNER
CREDA

EXPECTED SAVINGS: $450

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: Air sealing by weatherstripping and caulking installation of DHW tank insulating blanket, upgrade windows by adding magnitite, replace two doors, add insulation to attic.

MONITORING:
Pre and post retrofit air-tightness test.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)	2 cords	

AIR CHANGES PER HOUR (@ 50 Pa)
BEFORE: 8.45 AFTER: 6.87 % REDUCTION 18.6

AIR LEAKAGE L/m^2/sec.
BEFORE: 4.31 AFTER: 3.5 % REDUCTION 18.7

HOMEOWNER COMMENTS:

BEFORE	AFTER

CLIENT FACT SHEET

CLIENT NUMBER: WHS 0005 00B

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 29 year old, one storey wood frame house, full basement/crawl space. Hip roof. 416 m^3

ESTIMATED COST:

HOMEOWNER $720

CREDA $7200

ACTUAL COST:

HOMEOWNER $720

CREDA $7200

EXPECTED SAVINGS: $720

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - Envelope caulking. - window & door weatherstripping

- replace broken windows, upgrade stationary windows with magnatherm glazing
- upgrade main attic; complete interior ceiling air sealing
- upgrade furnace
- lower DHW temperature (tank already insulated)

MONITORING: Pre and post retrofit heating cost comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$1827 (4637 L)	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 7.88 AFTER: 5.01 % REDUCTION 36.4

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.35 AFTER: 2.13 % REDUCTION 36.4

HOMEOWNER COMMENTS:

BEFORE	AFTER
- cold rooms	
- leaky windows	

CLIENT FACT SHEET

CLIENT NUMBER: RIV 0221 229

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: An 8 year old, one and a half storey house, full basement, wood frame. 831 m^3 area.

ESTIMATED COST:

HOMEOWNER $1095

CREDA $5798

ACTUAL COST:

HOMEOWNER $1273

CREDA $5119

EXPECTED SAVINGS: $1095

ACTUAL SAVINGS: $877

RETROFIT TECHNICAL DETAILS: - envelope caulking to seal air leakages (using blower door). - window upgrading, magnatherm glazing to most windows.

- 3.5 RSI, styrfoam, interior/exterior of basement walls.
- DHW tank insulation.
- Furnance tuning and servicing.

MONITORING: Pre and post retrofit heating comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	3934 L	1984 L
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 4.79 **AFTER:** 3.44 **% REDUCTION** 28.1

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.09 **AFTER:** 2.22 **% REDUCTION** 28.1

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems	
- drafts	
- cold rooms	

CLIENT FACT SHEET

CLIENT NUMBER: DWN0004050

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 40 year old wood frame, two storey, brick faced house, full basement. 477 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 695	**HOMEOWNER**	$ 695
CREDA	$2,955	**CREDA**	$2,955
EXPECTED SAVINGS:	$695	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: - adjust and tune heating system.

- door and window weatherstripping. - insulate DHW tank.
- envelope caulking to seal air leakages, attic protrusion, seal shut existing storm windows.
- replace broken glazing on windows and add more magnatherm glazing to north facing windows.

MONITORING:

Pre and post retrofit heating comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	3,545 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 7.80 **AFTER:** 6.74 **% REDUCTION** 13.5

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.79 **AFTER:** 3.29 **% REDUCTION** 13.1

HOMEOWNER COMMENTS:

BEFORE	**AFTER**
- drafts	
- problems with heating system	
- necessary to use humidifier at all times.	

CLIENT FACT SHEET

CLIENT NUMBER: MCP0013000

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 3 year old, two storey, slab on grade log house, solar heated addition. 602 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$165	**HOMEOWNER**	$165
CREDA	$1,635	**CREDA**	$1,800
EXPECTED SAVINGS:	$165	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS:
- envelope caulking
- weatherstripping on east and west facing doors
- magnatherm upgrading on patio door on second floor and east and west facing slider windows.

MONITORING: Pre and post heating consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)	6 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: ______ **AFTER:** 6.22 **% REDUCTION** ______

AIR LEAKAGE L/m^2/sec.

BEFORE: ______ **AFTER:** 1.84 **% REDUCTION** ______

HOMEOWNER COMMENTS:

BEFORE	**AFTER**
- no problems noted	

CLIENT FACT SHEET

CLIENT NUMBER: ______

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 7 year old, one storey duplex, wood frame on full basement, electric heat, 290 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 455	HOMEOWNER	$ 455
CREDA	$4,550	CREDA	$3,795
EXPECTED SAVINGS:	$ 455	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:
- envelope caulking
- door weatherstripping
- upgrade main attic with R20 insulation
- upgrade windows; magnatherm liners in living room and bedroom windows. Cover over front entrance window.
- upgrade foundation - 1½ styrofoam and plywood.
- insulation DHW tank.

MONITORING: Participant in pre-retrofit monitoring program; pre and post retrofit heat consumption comparison, record indoor/outdoor temperature, humidity, and kWh meter for one month commencing 84/02/27.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 8.95 AFTER: ______ % REDUCTION ______

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.55 AFTER: ______ % REDUCTION ______

HOMEOWNER COMMENTS:

BEFORE	AFTER
- unreasonable electric heat costs	
- complaint of drafts, especially in basement, necessary to shut off basement doors in winter	
- very drafty front entrance.	

CLIENT FACT SHEET

CLIENT NUMBER: HIL0046000

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 30 year old, one and a half storey wood frame house with a full basement. Recently added porch, 330 m^3 area. Has been reinsulated.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 210	HOMEOWNER	$ 210
CREDA	$2,642	CREDA	$2,642

EXPECTED SAVINGS: $210 ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - envelope caulking to seal air leakages
- tune and service heating system. - insulate DHW tank.
- upgrade windows; seal sheet windows, add magnatherm glazing to living room, back porch and upstairs bedroom windows.
- upgrade attic, air vapour barrier, seal where walls and rafters meet.

MONITORING: Pre and post retrofit heating consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	634 L	
WOOD (m^2/cords)	10 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 7.70 AFTER: 4.90 % REDUCTION 36.3

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.50 AFTER: 2.23 % REDUCTION 36.2

HOMEOWNER COMMENTS:

BEFORE	AFTER
- some problems with moisture - window fogging	
- drafts	

CLIENT FACT SHEET

CLIENT NUMBER:

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 10 year old, one storey house, wood frame over full basement, 640 m^3 area. Has been reinsulated.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 310	HOMEOWNER	$ 310
CREDA	$3,100	CREDA	$1,570
EXPECTED SAVINGS:	$310	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS: - envelope caulking (with blower door)
- window weatherstripping
- window upgrading - magnatherm glazing in living room and basement
- insulate DHW tank
- upgrade basement - 1½" R 7.5 styrofoam to joist cavaties.

MONITORING: Pre and post retrofit heat consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 4.17 AFTER: 2.48 % REDUCTION 40.5

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.43 AFTER: 1.45 % REDUCTION 40.3

HOMEOWNER COMMENTS:

BEFORE	AFTER

CLIENT FACT SHEET

CLIENT NUMBER: R1V0031225

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 9 year old, one storey wood frame house. 547 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 445	**HOMEOWNER**	$ 445
CREDA	$4,550	**CREDA**	$4,035
EXPECTED SAVINGS:	$445	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS:
- envelope caulking
- upgrade all north-facing and picture windows with magnatherm glazing
- DHW tank insulation
- homeowner has option to upgrade basement walls with R7.5 styrofoam and sealant.

MONITORING: Participant in pre-retrofit monitoring program; pre and post retrofit heat consumption comparison, record indoor/outdoor temerapture, humidity, furnace operation for one month commencing 84/03/05.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	4,091 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems mainly with window fogging	

CLIENT FACT SHEET

CLIENT NUMBER: DAW00160HI

LOCATION: DAWSON CITY

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A four year old trailer set on piers. 193 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 535	**HOMEOWNER**	$ 535
CREDA	$4,565	**CREDA**	$4,565
EXPECTED SAVINGS:	$535	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: Air sealing by caulking and weatherstripping; install low flow shower head, and insulated blanket on DHW tank, lower DHW temperature; furnace servicing; add acrylic glazing to windows; upgrade front and back doors; insulate around bay-window.

MONITORING:

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	est. 2,900 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: ______ **AFTER:** ______ **% REDUCTION** ______

AIR LEAKAGE L/m^2/sec.

BEFORE: ______ **AFTER:** ______ **% REDUCTION** ______

HOMEOWNER COMMENTS:

BEFORE	**AFTER**

CLIENT FACT SHEET

CLIENT NUMBER: WHS0007059

LOCATION: WHITEHORSE

TYPE OF RETROFIT: . GROUP 2

HOUSE DESCRIPTION: A 30 year old, two storey log house with full basement. 628 m^3

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 430	HOMEOWNER	$ 430
CREDA	$4,300	CREDA	~~$4,300~~ 3[illegible]
EXPECTED SAVINGS:	$430	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:
- envelope caulking (using blower door)
- window and door weatherstripping
- upgrade heating system
- upgrade windows with magnatherm glazing
- upgrade basement with R12 fiberglas and 1½" R7.5 styrofoam to joist cavaties.
- insulate DHW tank.

MONITORING:

Pre and post retrofit heat consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	3,800 L	
WOOD (m^2/cords)	recently installed	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 9.14 AFTER: 4.98 % REDUCTION 45.5

AIR LEAKAGE L/m^2/sec.

BEFORE: 5.08 AFTER: 2.77 % REDUCTION 45.4

HOMEOWNER COMMENTS:

BEFORE	AFTER
- problems with drafts	
- very cold basement and upstairs	
- porch is very drafty	

CLIENT FACT SHEET

CLIENT NUMBER: RIV0007208

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 22 year old, one storey house, wood frame over full basement. 389 m^3 area. Contains apartment in basement. Has been reinsulated.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 515	**HOMEOWNER**	$ 515
CREDA	$2,545	**CREDA**	$2,545
EXPECTED SAVINGS:	$515	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: - envelope caulking

- weatherstripping doors and windows - adjust heating system.
- upgrade bedroom, kitchen and front door windows with magnatherm glazing. Also windows in basement suite.
- upgrade foundation; R20 fiberglas between joist cavaties and air seal with 1½"

MONITORING:

Pre and post retrofit heat consumption comparison

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	2,719 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 5.21 **AFTER:** 3.91 **% REDUCTION** 24.9

AIR LEAKAGE L/m^2/sec.

BEFORE: **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**

CLIENT FACT SHEET

CLIENT NUMBER: WHS0009047 2

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 30 year old, one storey house built over full basement. Reconstructed furnace plus some reinsulation and window replacement. 352 m^3 area.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 265	**HOMEOWNER**	$ 265
CREDA	$2,650	**CREDA**	$2,650

EXPECTED SAVINGS: $265 **ACTUAL SAVINGS:**

RETROFIT TECHNICAL DETAILS:
- envelope caulking
- upgrade attic with R20 insulation
- install damper in kitchen fan
- seal fireplace glass doors
- insulate DHW tank.

MONITORING: Participant in pre-retrofit monitoring program; pre and post retrofit heat consumption comparison; record indoor/outdoor temperature, humidity, and furnace operation for one month period commencing 84/03/05.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	1,575 L	
WOOD (m^2/cords)	6 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: **AFTER:** **% REDUCTION**

AIR LEAKAGE L/m^2/sec.

BEFORE: **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**
- moisture problems	

CLIENT FACT SHEET

CLIENT NUMBER:

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 30 year old one and a half storey wood frame unit with no basement.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$ 526	**HOMEOWNER**	
CREDA	$3,785	**CREDA**	
EXPECTED SAVINGS:	$526	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS: Air sealing by caulking and weatherstripping; install DHW tank blanket, and low-flow shower head; reduce DHW to 50°C; furnace servicing; upgrade attic insulation to RSI 7 install vapour barrier; add acrylic glazing to windows; upgrade insulation to 3.4 on exposed joist header cavities in basement.

MONITORING:

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	6,200 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: **AFTER:** **% REDUCTION**

AIR LEAKAGE L/m^2/sec.

BEFORE: **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**

CLIENT FACT SHEET

CLIENT NUMBER: WHS000J003

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 13 year old, one storey house, wood frame over full basement. 373 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 375	HOMEOWNER	$ 375
CREDA	$3,750	CREDA	$3,075
EXPECTED SAVINGS:	$375	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS: - envelope caulking throughout house, particularly to attic hatch and around plumbing stach, chimney, and recessed ceiling fixtures (Contractor to achieve 40% reduction)

- upgrade north facing double glazed windows with magnatherm liner
- add RSI 4.9 to attic after air sealing - insulate DHW tank
- install flow restrictor on shower head.

MONITORING:

Participant in pre-retrofit monitoring program; comparison of pre and post retrofit heat consumption; record indoor/outdoor temperature, humidity, and furnace operation for one month commencing 84/02/24.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	4,091 L	
WOOD (m^2/cords)	4 - 6 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 5.43 AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.58 AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- problems with drafts, especially around back porch	
- very leaky windows	

CLIENT FACT SHEET

CLIENT NUMBER: TGH0081804

LOCATION: TAGISH

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 20 year old, one storey log house with a full basement 243 m^3 area. Has been reinsulated.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 545	HOMEOWNER	$ 545
CREDA	$4,255	CREDA	$4,800
EXPECTED SAVINGS:	$545	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS: - replace single pane windows with thermal pane - styrofoam on concrete pony wall on exterior to bottom of footing and top where exposed, caulking between sill log and footing.

MONITORING: Pre and post retrofit heat consumption comparison. Total wood heat may not give sufficiently accurate picutre of difference.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)	14 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 8.32 AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.82 AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- quite high humidity level	
- very leaky around old, single pane windows	

CLIENT FACT SHEET

CLIENT NUMBER: WHS 0014 022

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 30 year old, one storey house, wood frame over full basement. Suite located in basement. Has been reinsulated. 267 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$325	HOMEOWNER	$325
CREDA	$2910	CREDA	$2250
EXPECTED SAVINGS:	$325	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:
- Envelope caulking
- Window and door weatherstripping
- Upgrade basement windows with magnatherm glazing.
- tuning/servicing heating system
- DHW tank insulation and temperature decrease.

MONITORING: Pre and post retrofit heating consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	1476 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: ______ AFTER: 8.84 % REDUCTION ______

AIR LEAKAGE L/m^2/sec.

BEFORE: ______ AFTER: 3.9 % REDUCTION ______

HOMEOWNER COMMENTS:

BEFORE	AFTER
- Serious complaint with heating system. Very old furnace, does not shut off when thermostat is turned down.	

CLIENT FACT SHEET

CLIENT NUMBER: WHS 000C 005

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 2

HOUSE DESCRIPTION: A 40 year old, 1½ storey wood frame house over basement/crawl space combination, 386 m^3 area. Has been reinsulated.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$320	HOMEOWNER	$320
CREDA	$3200	CREDA	$3200

EXPECTED SAVINGS: $320 ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS:
- Envelope caulking (to be done with blower door and achieve a 40% reduction).
- upgrade north and east facing, upstairs bedroom windows.
- install new front and back doors.
- insulate and lower temperature on DHW tank.

MONITORING: Pre and post retrofit heat consumption comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	3482 L	
WOOD (m^2/cords)	2 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- complaints of drafts.	

CLIENT FACT SHEET

CLIENT NUMBER: WHS0001058

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 40 year old, one storey house, wood frame over full basement. 236 m^3 area.

ESTIMATED COST:

HOMEOWNER $ 335

CREDA $2,910

ACTUAL COST:

HOMEOWNER $ 335

CREDA $2,910

EXPECTED SAVINGS: $335

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - envelope caulking

- window upgrading
- attic reinsulation
- heating system servicing
- DHW tank insulation and temperature decrease.

MONITORING: Pre and post retrofit heating consumption comparison

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	1,364 L	
WOOD (m^2/cords)	6 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 9.08 AFTER: 5.35 % REDUCTION 41.0

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.98 AFTER: 2.35 % REDUCTION 40.9

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems-window fogging	
- drafts	
- problems with heating system	

CLIENT FACT SHEET

CLIENT NUMBER: WHS0005113

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 43 year old quonset hut with full basement. Roof has been reinsulated and air sealed. 278 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 385	HOMEOWNER	$ 385
CREDA	$3,235	CREDA	$3,174

EXPECTED SAVINGS: $385 ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - envelope caulking

- window weatherstripping - DHW tank insulation
- window upgrading - three bedrooms, front room, living room and bathroom
- replace back door, weatherstrip front door
- exterior rewrap precluded on account of considerable structural work required complicated by additional insulation in roof and quonset shape.

MONITORING:

Pre and post retrofit heating consumption comparison

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	4,586 L	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 9.35 AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: 4.17 AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- foundation seriously in need of repair	
- moisture problems	
- drafts	
- cold rooms	

CLIENT FACT SHEET

CLIENT NUMBER:

LOCATION: WHITEHORSE

TYPE OF RETROFIT: GROUP 2

HOUSE DESCRIPTION: A 7 year old one storey wood frame house with full basement. 362 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$ 415	HOMEOWNER	$ 415
CREDA	$4,150	CREDA	$3,375
EXPECTED SAVINGS:	$415	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS: - door weatherstripping

- envelope caulking (using blower door and achieve 40% reduction)
- upgrade foundation walls; insulate joist cavaties, insulate, seal, and hyproc exposed concrete walls.
- insulate DHW tank.

MONITORING: Pre and post retrofit heat consumption comparison

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	2,540 L	
WOOD (m^2/cords)	5 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 4.29 AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.0 AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- no problems reported.	

CLIENT FACT SHEET

CLIENT NUMBER: PCK 0538 000

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: A 10-year old mobile home with small wood frame addition over a full basement/crawl space combination. 220 m³ area. Has been reinsulated.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$5,700	HOMEOWNER	$5,700
CREDA	$11,538	CREDA	$11,538
EXPECTED SAVINGS:	$1,640	**ACTUAL SAVINGS:**	

RETROFIT TECHNICAL DETAILS:

- total rewrap of building shell
- installation of new windows in renovated addition
- 4.9 RSI added to walls and attic
- 1.3 RSI added to interior and exterior of basement
- homeowner responsible for siding and vapour barrier in crawl space.

MONITORING: Post-retrofit monitoring program; pre-and post-retrofit heating cost comparison; record indoor/outdoor temperature, humidity, furnace operation for one month period commencing 84-02-19.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$2,131 Estimated; 441 L	
WOOD (m^2/cords)	7 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE:	9.70	AFTER:	4.41	% REDUCTION	54.5

AIR LEAKAGE L/m^2/sec.

BEFORE:	3.82	AFTER:	1.83	% REDUCTION	52.0

HOMEOWNER COMMENTS:

BEFORE	AFTER
- reports no problems except window fogging	- house feels warmer - more room, light, comfort - have not used oil furnace since retrofit complete

CLIENT FACT SHEET

CLIENT NUMBER: PCK 0199 000

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: A 15-year old, one storey log house with full basement. 251 m^3 area. Has been reinsulated.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$5,040	HOMEOWNER	$5,040
CREDA	$9,760	CREDA	$9,760

EXPECTED SAVINGS: $770/yr

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS:
- envelope caulking to seal air leakages
- total rewrap of building shell
- window upgrading, magnatherm liners on upstairs and basement windows
- 4.9 RSI added to walls, 7.0 RSI added to attic, 2.6 RSI to basement walls
- DHW tank insulation, temperature lowering, and install flow restrictor
- furnace servicing

MONITORING: Post retrofit monitoring program; pre-and post-retrofit heating cost comparison; indoor/outdoor temperature, humidity, furnace operation recording for one month period commencing 84-02-22.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$1,050	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 5.89 AFTER: 3.20 % REDUCTION 45.7

AIR LEAKAGE L/m^2/sec.

BEFORE: 2.5 AFTER: 1.36 % REDUCTION 45.6

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problem; window fogging	- house much warmer and more comfortable
	- no window fogging
	- lower fuel bills for last month

CLIENT FACT SHEET

CLIENT NUMBER: WHS 0008 ~~B~~OC

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: A 28-year old, one storey house. Wood frame over full basement 310m³ area. Has been reinsulated and air sealed.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$7,000	**HOMEOWNER**	$7,000
CREDA	$11,391	**CREDA**	$11,391

EXPECTED SAVINGS: $650 **ACTUAL SAVINGS:**

RETROFIT TECHNICAL DETAILS: - upgrade roof - extend 2 ft. and install new asphalt shingles; upgrade walls - new vapour barrier, acoustical sealing, install new curtain wall, insulate with R28 8" insulation, building paper, install new siding; upgrade basement walls - R10 2" styrofoam from existing water table to 2 ft. below grade, install treated 1/2" plywood and seal; upgrade windows - delete one entire front room window and decrease another, install 4 new fixed and opening window units. Extend door and window jambs and seal.

MONITORING: Post retrofit monitoring; pre and post retrofit heating cost comparison; record indoor/outdoor temperature, humidity, and furnace operation for one month commencing 84-02-22

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	3651 L $1,386	
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 2.90 **AFTER:** 2.87 **% REDUCTION** 1.0

AIR LEAKAGE L/m^2/sec.

BEFORE: **AFTER:** **% REDUCTION**

HOMEOWNER COMMENTS:

BEFORE	**AFTER**
- large windows in front room cool draughts in house	- very happy with retrofit
	- use furnace rarely during day and shut off at night
	- no draughts
	- no loss of light from less windows
	- lower fuel bill and less noise from outside traffic.

CLIENT FACT SHEET

CLIENT NUMBER: HIL 0072000

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: a 30 year old, one storey wood frame house with full basement 312m³ area. Homeowner has reinsulated and air sealed.

ESTIMATED COST:

HOMEOWNER $5,576

CREDA $11,011

ACTUAL COST:

HOMEOWNER $5,676

CREDA $11,011

EXPECTED SAVINGS: $5,576

ACTUAL SAVINGS:

RETROFIT TECHNICAL DETAILS: - envelope caulking to seal air leakages; total rewrap of building shell, include air-to-air heat exchanger; install new windows in addition, upgrade others with magnatherm glazing; add 4.9 RSI to walls, 7.0 RSI to attic, and 3.5 RSI to basement; insulate DHW tank and lower temperature; service furnace.

MONITORING: Post retrofit monitoring program; pre and post heating cost comparison. Record indoor/outdoor temperature, humidity, furnace operation for one month commencing 84-02-23.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL	$450	
WOOD (m^2/cords)	6 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: AFTER: % REDUCTION

AIR LEAKAGE L/m^2/sec.

BEFORE: AFTER: % REDUCTION

HOMEOWNER COMMENTS:

BEFORE	AFTER
- no problems noted	- complaint of moisture (homeowner was burning off 1-1½ gallons water each day) - house much warmer and brighter, larger more comfortable living area - can notice less demand for wood.

CLIENT FACT SHEET

CLIENT NUMBER: RIV0011 235

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION:

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$4,479	HOMEOWNER	$4,479
CREDA	$8,451	CREDA	$8,451
EXPECTED SAVINGS:	$4,479	ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:

- envelope caulking (seal using blower door); total rewrap of building shell; upgrade windows; add 4.9 RSI to walls, 1.3 RSI to basement; insulate DHW tank.

MONITORING: Pre and Post retrofit heating cost comparison.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY	$1,690	
FUEL OIL		
WOOD (m^2/cords)		

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 2.01 AFTER: 1.28 % REDUCTION 36.3

AIR LEAKAGE L/m^2/sec.

BEFORE: .944 AFTER: .601 % REDUCTION 36.3

HOMEOWNER COMMENTS:

BEFORE	AFTER
- serious moisture problems; window fogging and stains on ceiling and walls	- pleased with exterior finish
	- moisture stains on ceiling drying up
	- house feels much warmer, without heating all day
	- much less window fogging
	- very happy with already lowered electricity bills.

CLIENT FACT SHEET

CLIENT NUMBER: DWN 0056 001

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: a 30-year old, one storey wood frame house with full basement. 421 m^3 area.

ESTIMATED COST:		ACTUAL COST:	
HOMEOWNER	$5,700	HOMEOWNER	$5,700
CREDA	$11,300	CREDA	$11,300
EXPECTED SAVINGS:		ACTUAL SAVINGS:	

RETROFIT TECHNICAL DETAILS:

- exterior rewrap of building shell; air sealing by caulking and weather-stripping; install low-flow shower head, and insulating blanket on DHW tank, reduce DHW to 50°C; service and tune boiler; foundation insulation; upgrade windows with acrylic glazing

MONITORING: Participant in pre-retrofit monitoring program; comparison of pre- and post-retrofit heating consumption comparison, record indoor/outdoor temperature, humidity, and furnace operation for one month commencing 04-03-12.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	BEFORE	AFTER
ELECTRICITY		
FUEL OIL		
WOOD (m^2/cords)	14 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 5.61 AFTER: 3.91 % REDUCTION 30.3

AIR LEAKAGE L/m^2/sec.

BEFORE: 3.46 AFTER: 2.41 % REDUCTION 30.3

HOMEOWNER COMMENTS:

BEFORE	AFTER
- moisture problems.	

CLIENT FACT SHEET

CLIENT NUMBER: PCK 0304000

LOCATION: Whitehorse

TYPE OF RETROFIT: Group 3

HOUSE DESCRIPTION: A 40 year old, one storey wood frame house moved to present location. Foundation of full basement/crawl space.

ESTIMATED COST:		**ACTUAL COST:**	
HOMEOWNER	$7,000	**HOMEOWNER**	$7,000
CREDA	$11,300	**CREDA**	$11,300

EXPECTED SAVINGS: ______ **ACTUAL SAVINGS:** ______

RETROFIT TECHNICAL DETAILS: - total rewrap of building shell (air to air heat exchanger not included). - homeowner made addition contribution of $1300 for new windows. - 4.9 RSI added to walls, 7.0 RSI to roof, 3.5 RSI to basement.
- DHW tank insulation.
- Furnace servicing.

MONITORING: Post retrofit monitoring program; pre and post retrofit heating cost comparison; record indoor/outdoor temperature, humidity, furnace operation for period of one month commencing 84-02-23.

PRE-AND POST-RETROFIT CHARACTERISTICS:

ENERGY CONSUMPTION:	**BEFORE**	**AFTER**
ELECTRICITY		
FUEL OIL	1767 L	1492 L
WOOD (m^2/cords)	4 cords	

AIR CHANGES PER HOUR (@ 50 Pa)

BEFORE: 10.96 **AFTER:** ______ **% REDUCTION** ______

AIR LEAKAGE L/m^2/sec.

BEFORE: 5.52 **AFTER:** ______ **% REDUCTION** ______

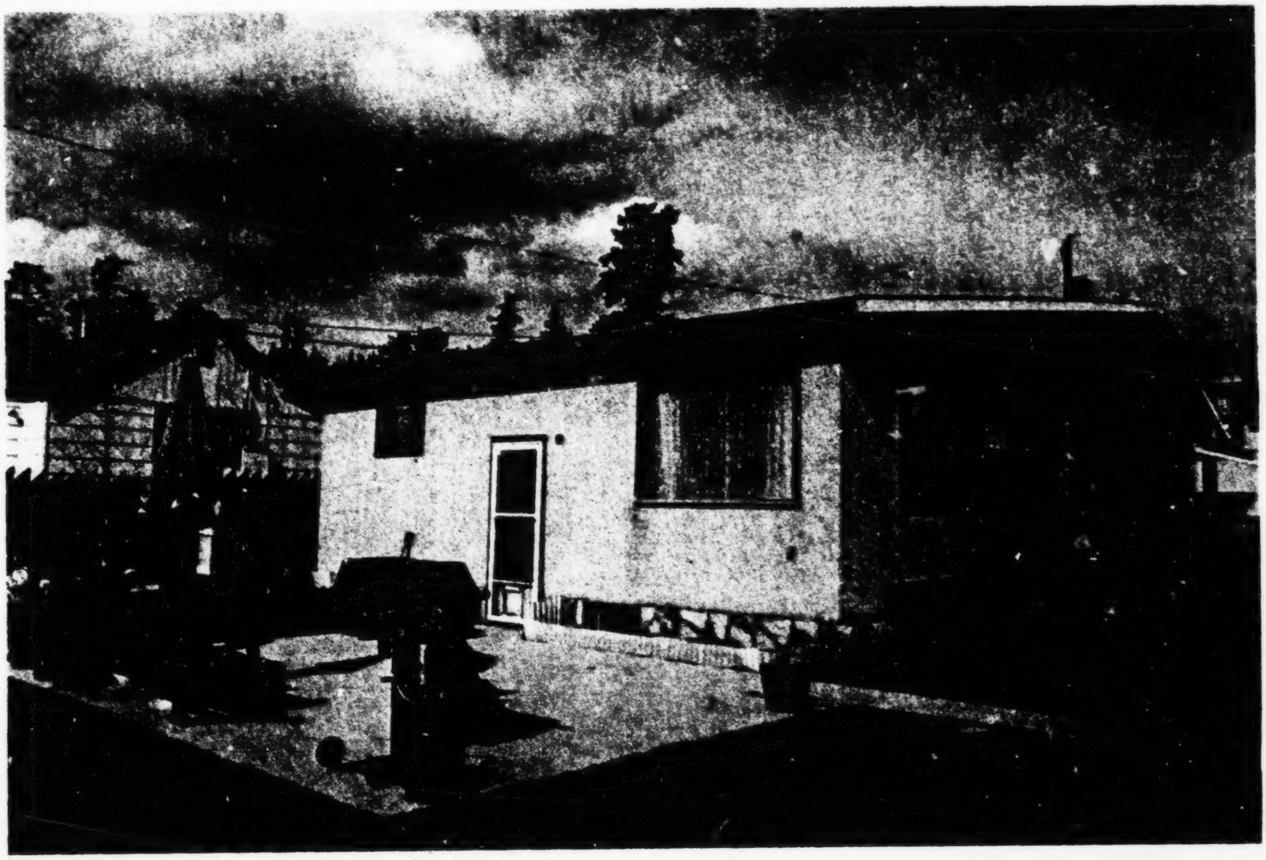
HOMEOWNER COMMENTS:

BEFORE	**AFTER**
- problem with moisture-heavy window fogging.	- house much warmer, brighter, and more comfortable
- leaky windows and doors.	- complaint of peeling window/door frames (increased pressure from new roof causing walls to shift outward causing separation of frames from building. Presently under YHC observation).

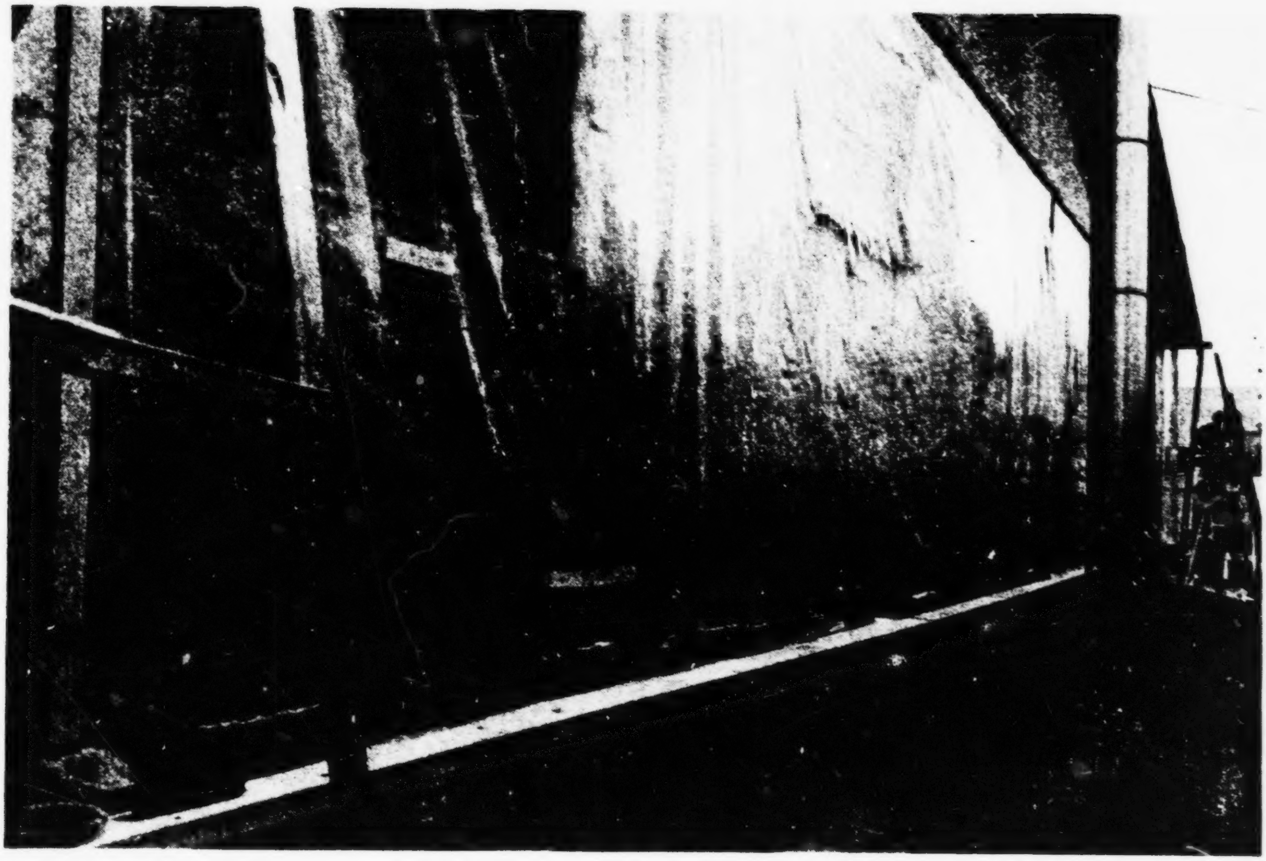
APPENDIX D

Photographic Representation Of a Full Wrap

The house to be retrofitted was a 30 year old, one storey wood frame house, 421 cubic meters in volume with a full basement.

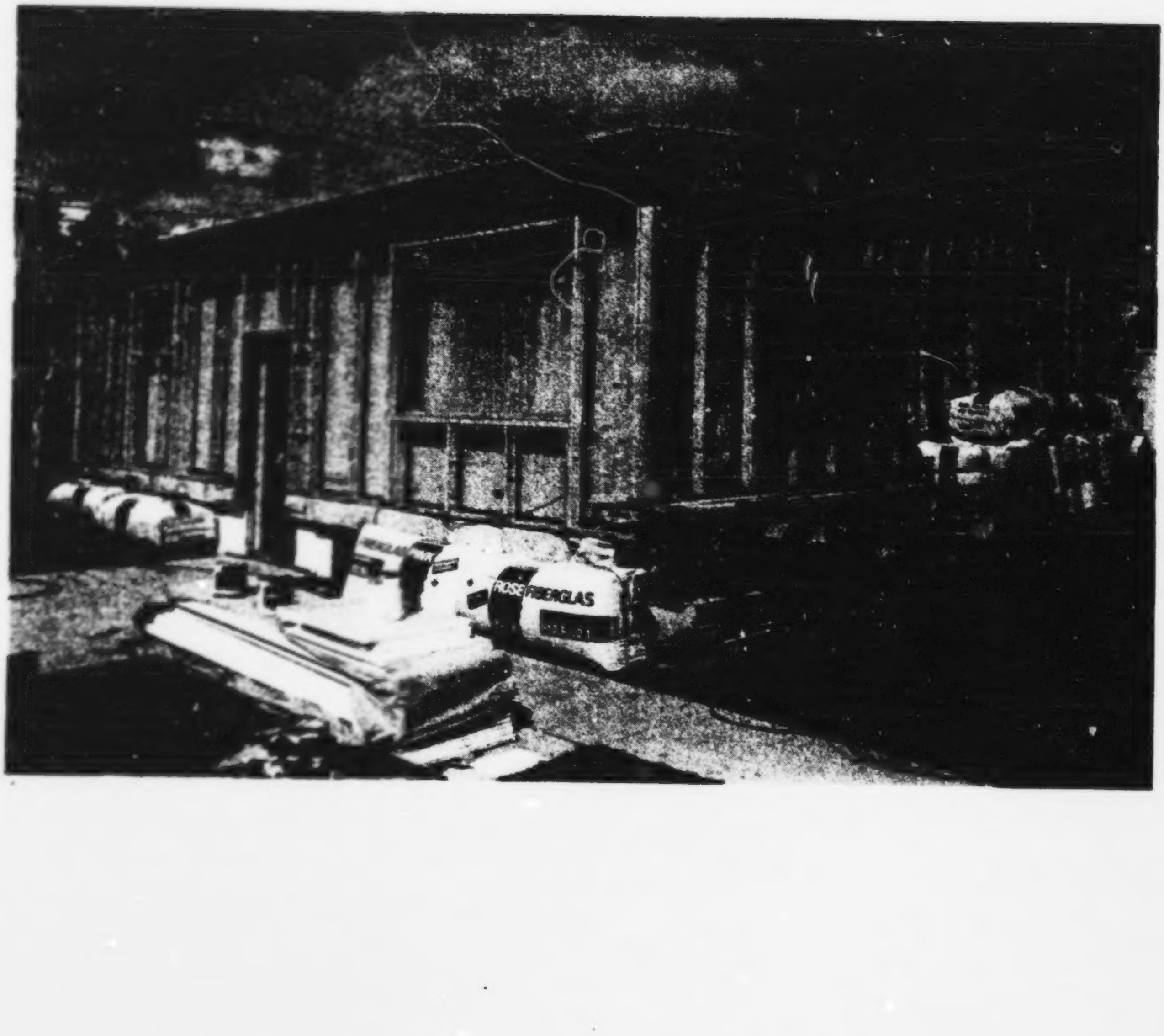


Standard approach to the wrap included the use of 6 mil poly for the air-vapour barrier. The wall technique to be used was curtain wall, or non-load-bearing wall. The structure seen at the bottom of the house will support the curtain wall. Below grade insulation is just visible. It consists of blue styrofoam panels to a depth of 0.6 meters.

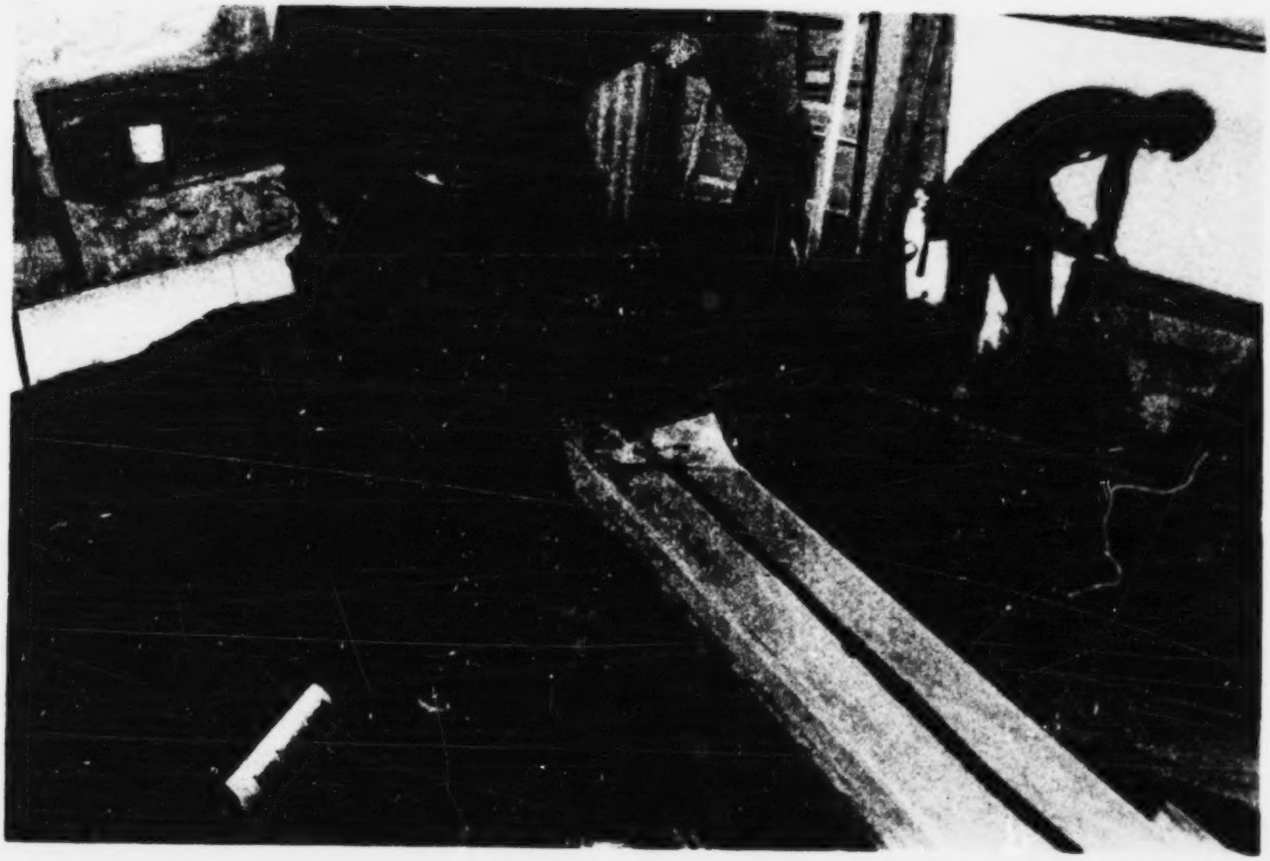


In order to accomodate the extra wall thickness in this house, only the gable ends needed to be extended.

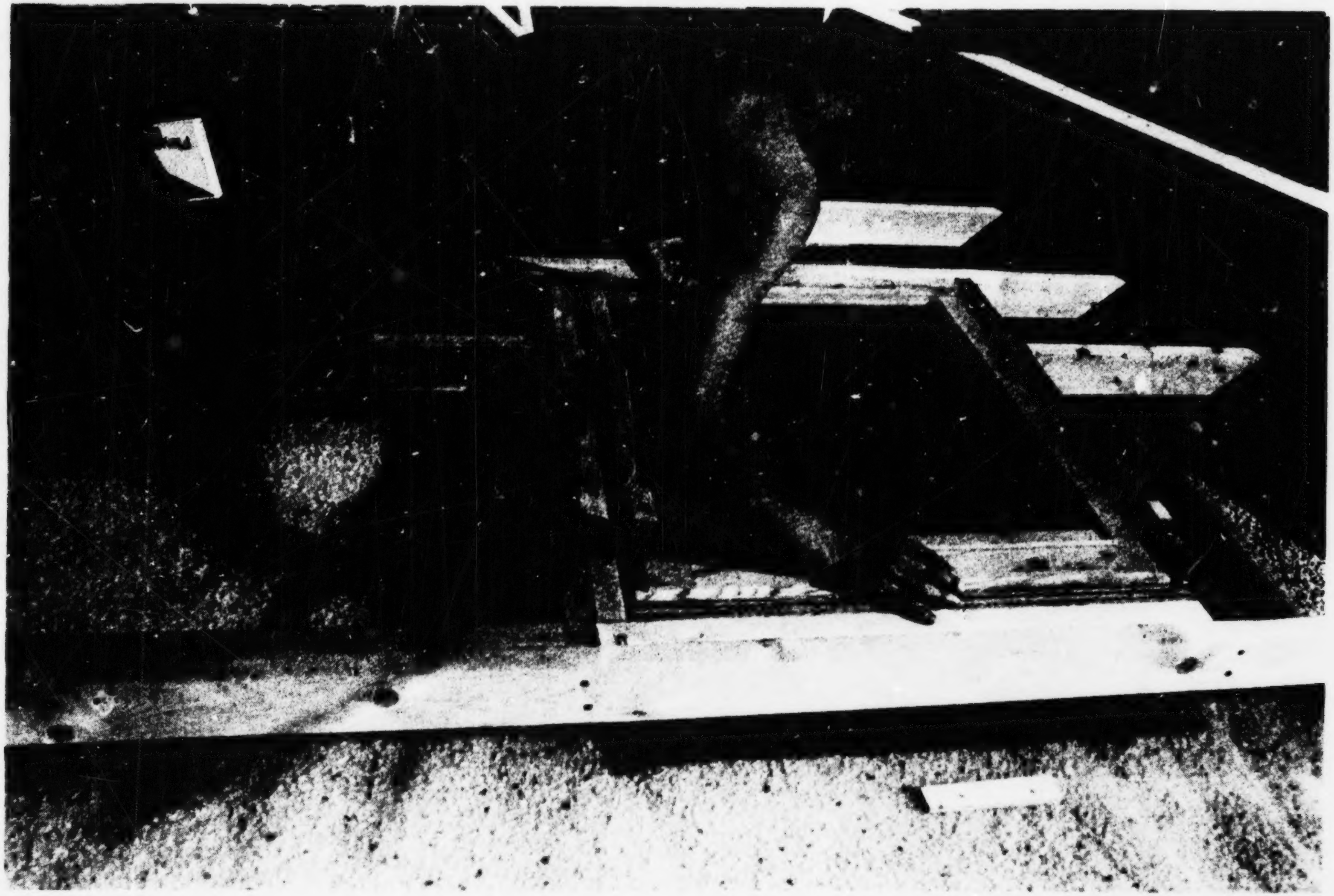
The curtain wall is in place. Notice that it is separated from the original wall leaving a space of between three and four inches to accomodate an extra layer of fibre-glass insulation between the studs and the original wall. The curtain wall is a light, 2 x 4 construction.


ROSE FIBERGLAS

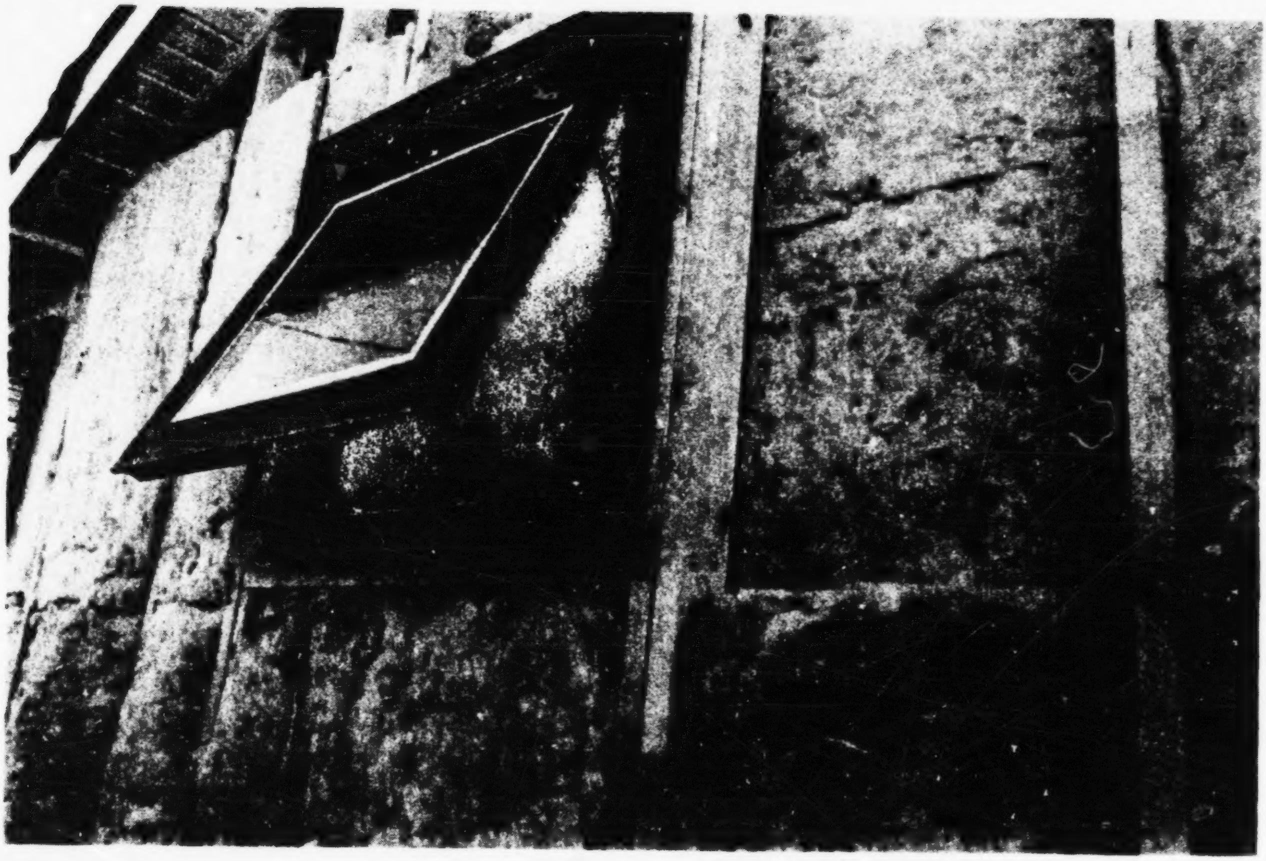
Attention to detail is the key to an effective retrofit. In this photo the carpenter is preparing windows prior to installation. Having placed a wide strip of 6 mil poly around the frame of the window and utilized acoustical sealant to prevent air movement between the frame and the poly, he is lapping the corners to provide for easier attachment to the main a-v barrier.



The windows are placed in location and carefully adjusted so they are plumb before the a-v barrier is joined to the poly around the window frame. This technique ensures a complete and integral air vapour barrier.

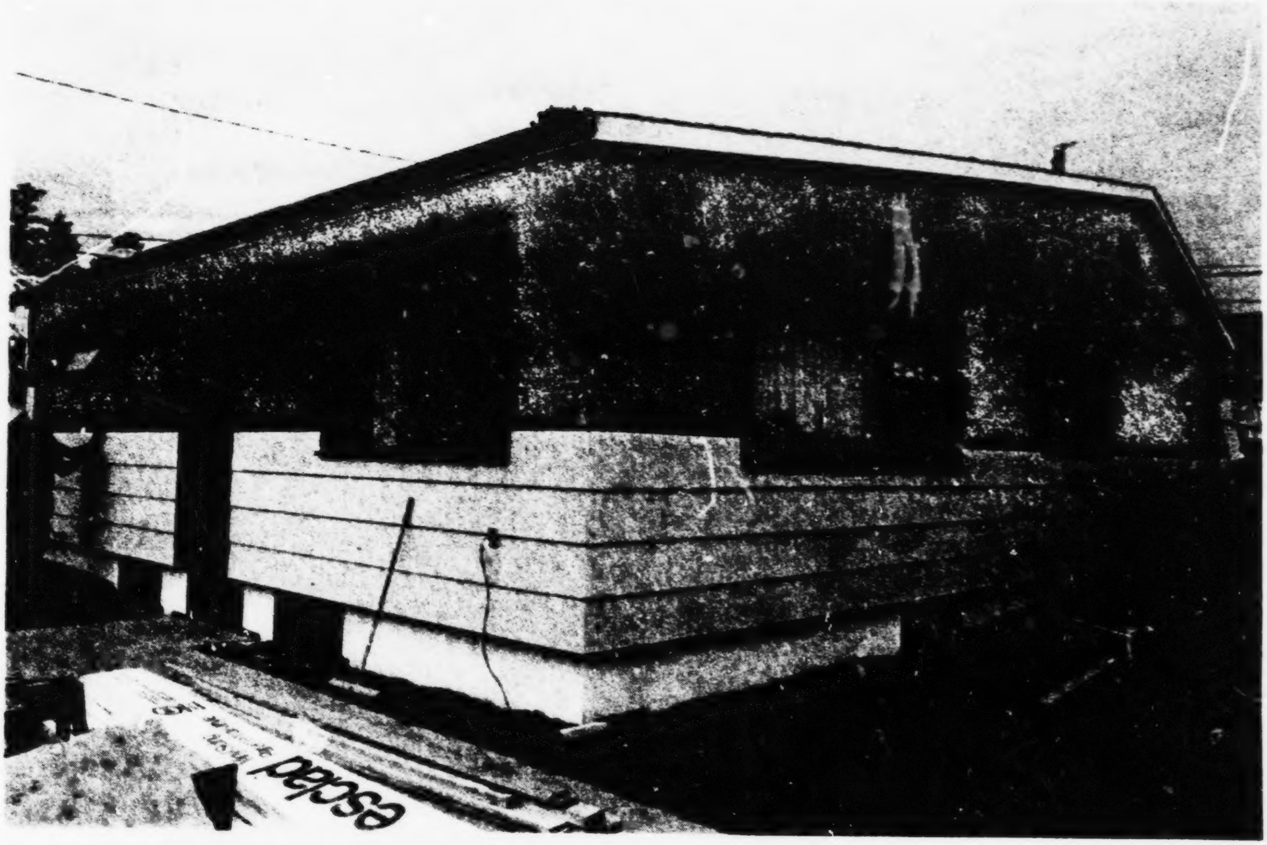


The window is plumb and the a-v barrier is completely sealed around the rough opening. One layer of fiber glass insulation has been place horizontally between the original wall and the studs of the curtain wall. The second layer of fiber glass is being placed vertically between the studs. This insures that the batts will not shift and that there will not be a thermal bridge.



The insulation is in place and the final details are being attended to.

The final step is the installation of siding, in this case vinyl, and trim. The total cost of the retrofit was $17,000. There was a reduction in ELA from 3.46 to 2.41. The occupant used 14 cords of wood to heat his home annually before the retrofit compared to about five after the retrofit.



Energy, Mines and Resources Canada	Énergie, Mines et Ressources Canada

Yukon
Department of Economic Development and Intergovernmental Relations

SENIOR CITIZENS RETROFITS

Final Project Summary

Canada/Yukon Conservation and Renewable Energy Demonstration Program

Project No.
3766-4-3

Project Locations:
Whitehorse, Dawson, Tagish

Project Manager:
Robert E. Collins

Date:
February, 1985

Technology:
Retrofit

Status:
Completed

Sectors:
Residential

Jurisdiction:
Yukon

Purpose:

1. To determine the cost effectiveness of a range of energy conservation measures in the residential sector under Yukon conditions.
2. To train local tradespeople in energy efficient construction techniques, and to make them aware of the importance of such techniques.

Description:

A total of 38 homes and two apartment buildings for senior citizens received various degrees of retrofit work ranging from air sealing, addition of extra insulation to a total rewrap of the building exterior. In order to have the work done by qualified and knowledgeable tradesmen, a 20 day and a three day course were given for contractors or tradesmen to inform them of the latest techniques and materials used in energy efficient construction.

Contributors:

CANADA (75%)	$284,174.25
YUKON (25%)	94,724.75
	$378,899.00

Further Information:

Mr. Robert Collins, Project Manager and/or Mr. David Arseneault, Information Officer, Department of Mines and Small Business, Government of Yukon, Whitehorse, Yukon Y1A 2C6 (403) 667-5382.

Demonstrated Benefits:

1. Better quality, more energy efficient homes that are warmer in winter, less drafty and have a more comfortable humidity level.
2. Reduction in energy consumption, and consequently savings on energy bills.
3. Increased knowledge and understanding of retrofit techniques.
4. Increased awareness of the importance of retrofit measures and their benefits.
5. Inception of competent retrofitting industry, employment for local qualified tradesmen and increased business for local building material suppliers.

Technical Details:

Each home of the senior citizens who participated in the program received an energy audit to determine how much work was needed to make the home more energy efficient. A total of 31 houses had minor or medium level of retrofit work done, including airsealing (as determined by an airtightness test), installation of a DHW tank insulating blanket, upgrading of windows, furnace servicing, and extra insulation in the attic. A total of 7 houses received a major exterior rewrap, plus some of the work in the lower levels of retrofit. In addition, one older 22-unit apartment for senior citizens received a rewrap retrofit, and a second newer apartment received medium level retrofit work.

Economic Analysis:

Building	Expenditure	Annual Saving	Payback (yrs)
Greenwood/Bishop's House	$ 24,015	$ 5,770	4.2
Alexander Lodge	159,000	9,347	17.0
Group II Houses	118,954	23,770	5.0
Group III Houses	115,454	5,830	19.6
Total	$ 417,423	$ 44,768	9.3